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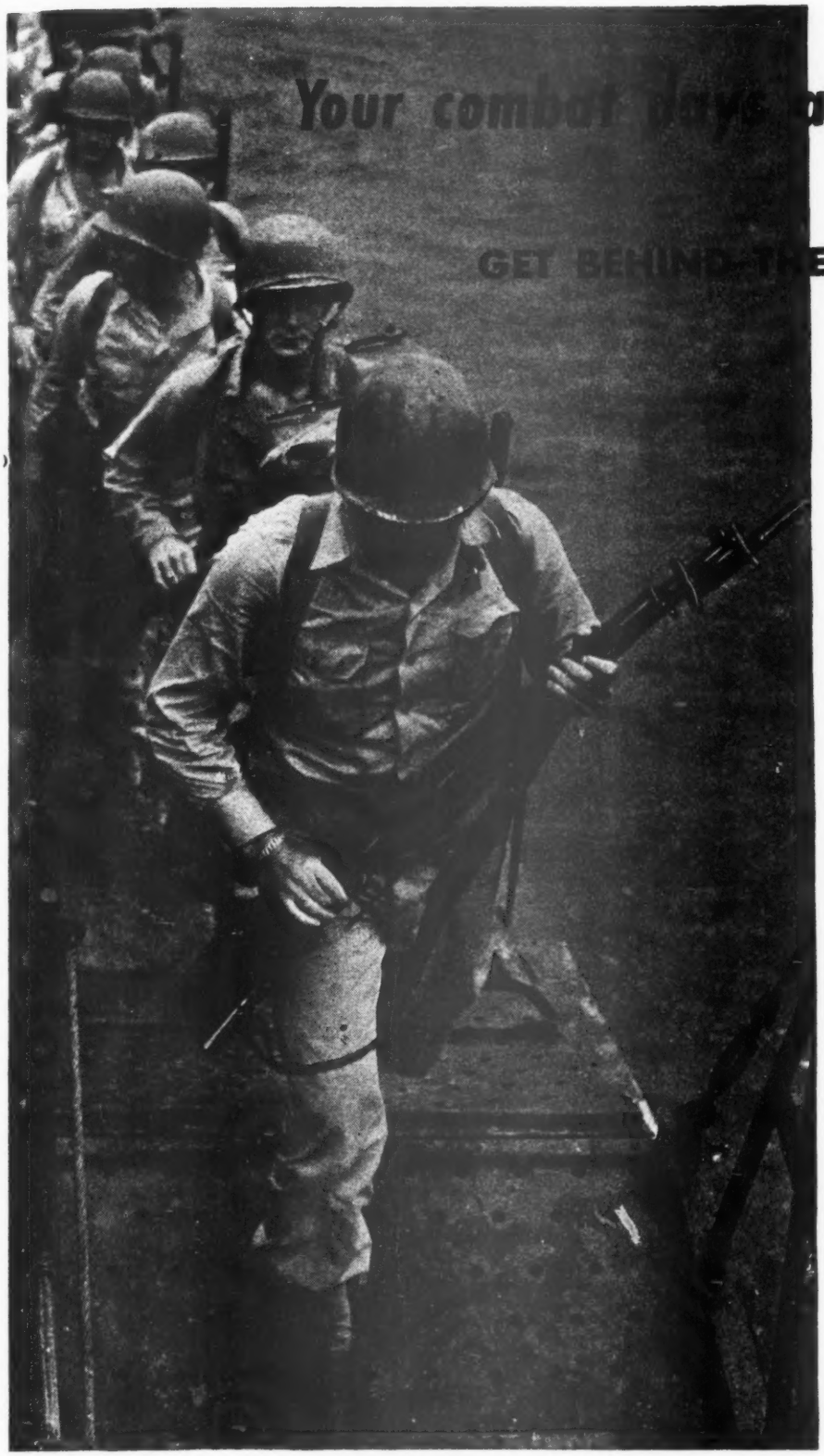

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The Course of Oil

by K. C. SCLATER

THE STERLING AREA PROBLEM

In July, 1940, Britain was driven by dire circumstances arising from the war to adopt drastic measures in order to conserve her financial resources. The course taken was to block all sterling exchange surpluses derived from current business between the United Kingdom and Empire countries and also several neutral countries. Agreements negotiated with each of these countries were made on a voluntary basis and the action taken was bilateral rather than unilateral in character. Thus was the sterling area brought into being. As its name implies, the sterling area is the term applying to the group of countries in which sterling exchange is closely controlled. Its purpose is to prevent excessive demands for gold and foreign exchange at times when it may not be convenient to meet them.

In operation, the sterling area requires that equipment and supplies to be used in British industry or in countries within the sterling area, be procured from sterling sources—that is, from countries within the sterling area. If an American oil company operating in Egypt, for example, needs equipment for its development operations in that country, Egypt being in the sterling area the equipment must be procured from a sterling source—probably a manufacturer in Britain if he can supply the needed equipment.

Among the difficulties now being encountered are those involved in the procurement of equipment and supplies for foreign oil operations. These difficulties stem directly from sterling area restrictions. The simple example just cited of an American company in Egypt is but one instance of how the sterling area works in the foreign oil trade.

There are other aspects of this restrictive measure, however, that are of immediate concern to American companies operating in foreign oil fields within the sterling area. One is whether specific types of necessary equipment and supplies peculiar to the oil industry can be procured from sterling sources in time and in quantity to meet the heavy demands of foreign oil operations when development programs now in the mill get under way. Another is the price differential of 15 to 20 per cent in favor of British manufacturers on equipment purchased by American oil companies from sterling sources. Of interest in this connection are the plans of British manufacturers to capture a larger share of the oil equipment market. A group of British manufacturers got together early in 1943 and formed the Council of British Manufacturers of Petroleum Equipment, which "is an association of those companies or groups manufacturing in the United Kingdom or Northern Ireland who have for some considerable time specialized in the manufacture of equipment or component parts of equipment for any aspect of the petroleum industry—from the search for, winning, storage, transportation, treatment, refining, to the distribution of petroleum and its products."

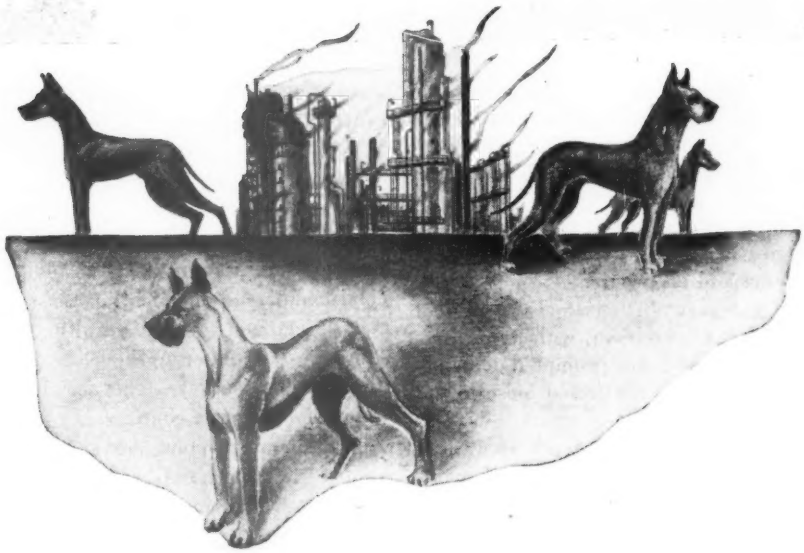
The chairman of this group in addressing the members of the association said that "some of us were greatly impressed with the desirability of establishing some form of organization in connection with the petroleum equipment industry to insure that British industry should obtain a fair proportion of postwar rehabilitation of destroyed oil properties." The purposes of the association were later expanded to "embrace the whole of this (the petroleum) branch of British industry, and one that could speak authoritatively to government departments, and to national bodies of similar or allied interests.

"This organization would have to be of an educative, publicity and propaganda type dealing with a broad, common policy, and having nothing to do with trading, trade associations, price fixing and the like.

"This concept . . . would unify this section of industry and create an aggressive forward policy. It would fully represent their industry's views to government departments, and so enable British Government officials concerned with post-war commercial negotiations to be fully conversant with the scope of their industry and its capacity for future business."

Solution of the sterling area problem would be its elimination, but that is a matter that has many ramifications and one that has far-reaching considerations involving Britain's national economy. Bearing on this question, a comment taken from an economic paper published by the American Chamber of Commerce in London in May of this year, points out that "it would be unwise to assume that restrictive measures will be a permanent feature of British government policy. Any postwar restrictive measures should be regarded as temporary expedients to meet an emergency situation, and constant pressure will be exerted toward their removal as soon as there is a reasonable prospect of balancing Britain's external payments and receipts on current account."

Although the sterling area is a war measure designed to conserve Britain's financial resources in international trade, the resultant effects of its continuance into the postwar period cannot but have a retarding influence on operations of American oil companies in foreign fields.



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Scanning WASHINGTON'S OIL HORIZON

WASHINGTON—Interior Department is counting on the airborne magnetometer to map oil prospects of the Continental Shelf, that submerged region extending for as much as a hundred miles from our shores, which was recently proclaimed as public domain.

This instrument, a wartime development by the Navy, already has been tested by the U. S. Geological Survey in geophysical magnetic surveys in Oklahoma and elsewhere.

It was in the hush-hush category during the war period. One oil company was "in the know", however, with its own research paralleling that of the Navy. This has prompted demands from other companies that the "secret" be turned loose to the entire industry now that the war is over.

This "flying doodlebug" is said to map the depth as well as structure of magnetic formations, more accurately and many times faster than similar surveys on the ground. For subsea formations, it has obvious advantages. It will be a big step forward in oil exploration, according to officials here.

It uses a fluxgate magnetometer, mounted in an aluminum framework, which is similar to an aerial torpedo. This is called the "bird." It is towed by an airplane. The cable, several hundred feet long, feeds impulses to recording instruments mounted in the plane. An aerial camera photographs the terrain and the instrument readings simultaneously.

It is claimed that the resulting data are more detailed and more closely related to the geologic structure than similar data from ground surveys. The aerial survey provides for contour maps made from a continuous curve rather than interpolations from a point-by-point survey from the ground. Another advantage is that the airborne instrument is unaffected by rails, pipes, and other metallic objects.

● **CONTINENTAL SHELF.** Proclamation of federal "ownership" of oil and other mineral deposits in the Continental Shelf was regarded here as an effort by Secretary Ickes to throw dust in the eyes of Congress as it was considering the Sumners-McCarran resolution quitclaiming federal rights to submerged lands in favor of the states.

Of course, it was President Truman who issued the proclamation—but he had to be "sold" on the idea by Ickes. And Ickes' success as a salesman has alarmed some proponents of the tidelands quitclaim resolution who fear that it may foreshadow a veto *if* the measure gets by Congress. The House passed it by a 108-to-11 vote. On the Senate side, however, sentiment is developing for no action until the courts have had a whack at the whole issue, which they regard as including the Continental Shelf as well as submerged lands within the 3-mile limit.

Meanwhile, an extension until December 19 has been granted to Pacific Western Oil Corporation in which to answer the government's suit to enjoin drilling and production from submerged lands off the California coast.

● **DEMAND.** The military has revised estimates of its requirements for petroleum products so that total demand on the U. S. oil industry—including civilian needs—during the next six months is now forecast at: Gasoline, 1,625,000 bbl. per day; distillates, 735,000 bbl. per day; residual fuel, 1,225,000 bbl. per day; kerosine, 225,000 bbl. per day; and minor amounts for miscellaneous products.

These estimates contemplate refinery runs of about 4,500,000 bbl. per day during the last quarter of 1945 and 4,300,000 bbl. per day during the first three months of 1946, with distillate yields averaging 16.7 per cent over the six-month period.

● **PERCENTAGE DEPLETION.** U. S. Treasury's presentation to the Ways and Means Committee on the interim tax bill didn't mention percentage depletion—but high-ranking departmental officials haven't changed their minds on this matter. They still believe the allowance is overly-generous. Unless called off by higher-ups, they are prepared to renew their attack on percentages depletion when the congressional committee starts work early next year on a general revision of the tax structure.

● **DISPOSAL OF BIG INCH.** At first, the larger oil companies appeared firmly convinced that neither the Big Inch nor Little Big Inch pipe lines could be used after the war. They were practically unanimous in their lack of interest in using the lines. Lately, however, some have changed their tune a bit. They are leaving the door slightly ajar. At least one major company has advised government officials that it is interested in using the 20-in. products line, if there is a joint plan proposed for operating it. Several large independent marketers on the East Coast have said the same thing, even nominating how many thousands of barrels they could take daily. The co-operatives also are showing interest.

Several large independent producers in the Southwest have suggested the Big Inch line be continued in operation as a joint venture. They have interested high-ranking Democratic politicians in furthering their case.

Present plans call for both lines to be drained with a treated water line-fill, followed by an inert gas. Water was started into the products line on September 30.

● **100-OCTANE.** Military authorities have found that they greatly over-estimated their current and future needs for 100-octane gasoline. Postwar consumption is turning out to be far less than anticipated. Instead of using up all 100-octane stocks by December 31, they now figure it will be May or June next year before inventories are down to minimum working levels. Currently, there is around 15,000,000 bbl. of 100-octane in the military stockpile in this country. There has been some talk of turning back some of this aviation gasoline to refiners for blending down to motor fuel. But the government would take a huge loss, making this politically dangerous.

● **OIL PRICE CONTROL.** Refinery strikes only made it more certain that oil price control would be one of the very last to be removed by OPA. Even before that, however, OPA had become convinced that proration laws kept crude supply so well in balance with demand they could not use the supply-demand yardstick to determine when crude price ceilings could be removed.

● **API SUIT.** U. S. Attorney General Tom Clark is still studying what to do with the "Mother Hubbard" anti-trust suit against the American Petroleum Institute and 300-odd oil company defendants. Some high-ranking officials of the Department of Justice believe the 1940 complaint is outmoded, others feel that something in the way of a consent decree can be salvaged. Meanwhile, Clark is being peppered with letters from Capitol Hill urging that the API suit be brought to trial. These letters are inspired by the same group that brought about the Madison oil case.

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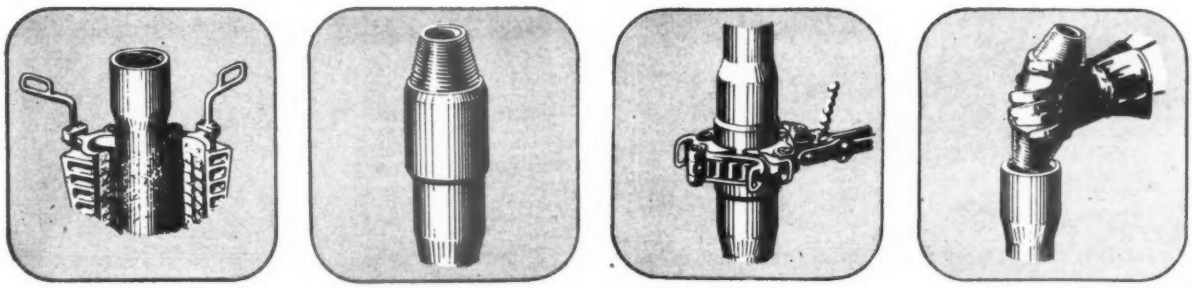

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NATIONAL PETROLEUM SITUATION

PRODUCTION OFF 9 PER CENT. September crude production, reflecting cutbacks in Texas and California, dropped 9 per cent under August. Daily production was cut 420,000 bbl. to 4,467,000. Further substantial cutbacks are expected in October. Texas production declined 383,000 bbl. daily, while California output dropped 50,000 bbl.

DEMAND SHARPLY REDUCED. Crude oil demand in September decreased about 811,000 bbl. daily, due primarily to shut-downs over labor disputes. Refinery runs dropped to a daily average of but 4,333,000 bbl. a net reduction under August of 688,000 bbl. The balance of the reduction was apparently due to lower exports.

STOCK POSITION IMPROVED. Sharp cuts in demand are having the effect of improving the oil industry's stock position. The number of days of supply, representing the ratio of stocks to daily demand, is being lengthened. As further postwar adjustments are made, the industry's stock position is expected to show further improvement. Wartime stocks, which were far below required working levels, may soon prove to be adequate for reduced requirements.

DRILLING AT QUOTA LEVEL. Well completions in the first 9 months of this year are practically at the quota level for this year. Completions totaled 20,082, against a quota to October 1 of 20,202 wells. Development wells exceeded the quota by 3.3 per cent. Wildcat drilling, however, is shown to be about 18 per cent under the quota set for this year. The quota to October 1 was about 3,740 wells, whereas the industry only completed 3,076 wildcats in the first 9 months.

GASOLINE STOCKS OFF. Reduced gasoline production in September, due to refinery shut-downs, caused a decline in stocks of nearly 5,000,000 bbl. A substantital decline in domestic and foreign consumption of motor fuel, however, had the effect of reducing the stored supply by only 1 day. At the close of August, gasoline stocks were sufficient to last 3 days, while on October 1, despite reduced output, the supply amounted to 32 days.

LESS FUEL OIL OUTPUT. As in the case of motor fuel, the production of light and heavy fuel oils was substantially cut in September. Yet, due to reduced demand, stocks of fuel oil increased about 2,600,00 bbl. The incréase in stocks, coupled with lower demand, had the effect of increasing the number of days supply from 43 to 47 days.

GASOLINE YIELD HIGHER. Readjustment of refining operations in September is shown to have increased the yield of gasoline from crude to about 42.9 per cent, from 41.6 in August. Further improvement in this respect, with a relatively reduced demand for crude, is to be expected.

Comparative Statistics, September, 1945

*All figures are computed on a Bureau of Mines basis**

	Spet. 1945	August 1945	Sept. 1944	This year to date	Last year to date	Per cent change
Wells drilling	4,100	¶4,150	4,215	4,100	4,215	— 3
Total wells drilled	2,423	2,346	2,060	20,082	16,062	+25
Development wells	2,057	2,007	1,742	17,006	13,241	+28
Oil	1,248	1,219	1,193	10,397	9,173	+13
Gas	239	213	205	1,869	1,561	+20
Dry	570	575	344	4,740	2,507	+89
Per cent dry	27.7	28.6	19.7	27.9	18.9	+ 9.0
Wildcat wells	366	339	318	3,076	2,821	+ 9
Oil	53	35	44	411	344	+19
Gas	12	15	13	106	91	+16
Dry	301	289	261	2,559	2,386	+ 7
Per cent dry	82.2	85.3	82.1	83.2	84.6	— 1.4
Crude production	134,010	151,500	142,989	1,306,918	1,243,129	+ 5
Daily average	4,467	4,887	4,766	4,787	4,537	
Crude demand†	132,600	162,160	147,646	1,362,036	1,295,022	+ 5
Daily average	4,420	5,231	4,922	4,989	4,726	
Crude stocks	224,940	217,705	229,337	224,940	229,337	— 2
Days supply	51	42	47	51	47	
Natural gasoline production	8,360	¶9,517	8,448	83,519	73,335	+14
Daily average	279	307	282	306	268	
Motor fuel production	62,890	¶72,950	63,674	608,969	547,328	+11
Daily average	2,096	2,353	2,122	2,231	1,998	
Gasoline yield, per cent	42.9	¶41.6	39.9	40.9	39.0	+1.9
Motor fuel demand	68,250	¶73,067	65,745	615,053	549,362	+12
Daily average	2,275	2,357	2,192	2,253	2,005	
Motor fuel stocks	72,220	¶77,330	69,055	72,220	69,055	+ 5
Days supply	32	33	32	32	32	
Fuel oil production	53,560	64,350	57,013	547,152	521,012	+ 5
Daily average	1,785	2,076	1,900	2,004	1,902	
Fuel oil demand	54,750	¶59,830	55,574	595,937	568,555	+ 5
Daily average	1,825	1,930	1,852	2,183	2,075	
Fuel oil stocks	85,975	¶83,300	101,536	85,975	101,536	—15
Days supply	47	43	55	47	55	
Refinery still runs	129,990	155,650	140,453	1,312,116	1,236,794	+ 6
Daily average	4,333	5,021	4,682	4,806	4,514	
All refined stocks	235,560	¶239,400	253,014	235,560	253,014	— 7
Days supply	47	46	51	47	51	

*Unless otherwise stated all figures represent thousands of barrels.
†Domestic and foreign. ¶Revised.

Crude Prices by States for September, 1945

Nine months ending September, 1945

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	20,202	20,082	99
Production (daily crude output)	4,771	4,787	100
Refining (daily still runs)	4,865	4,896	99
Stocks (crude and refined)	472,316	460,500	97
Price of crude (per bbl.)	$1.98	$1.22	62

Crude Prices by States for September, 1945§

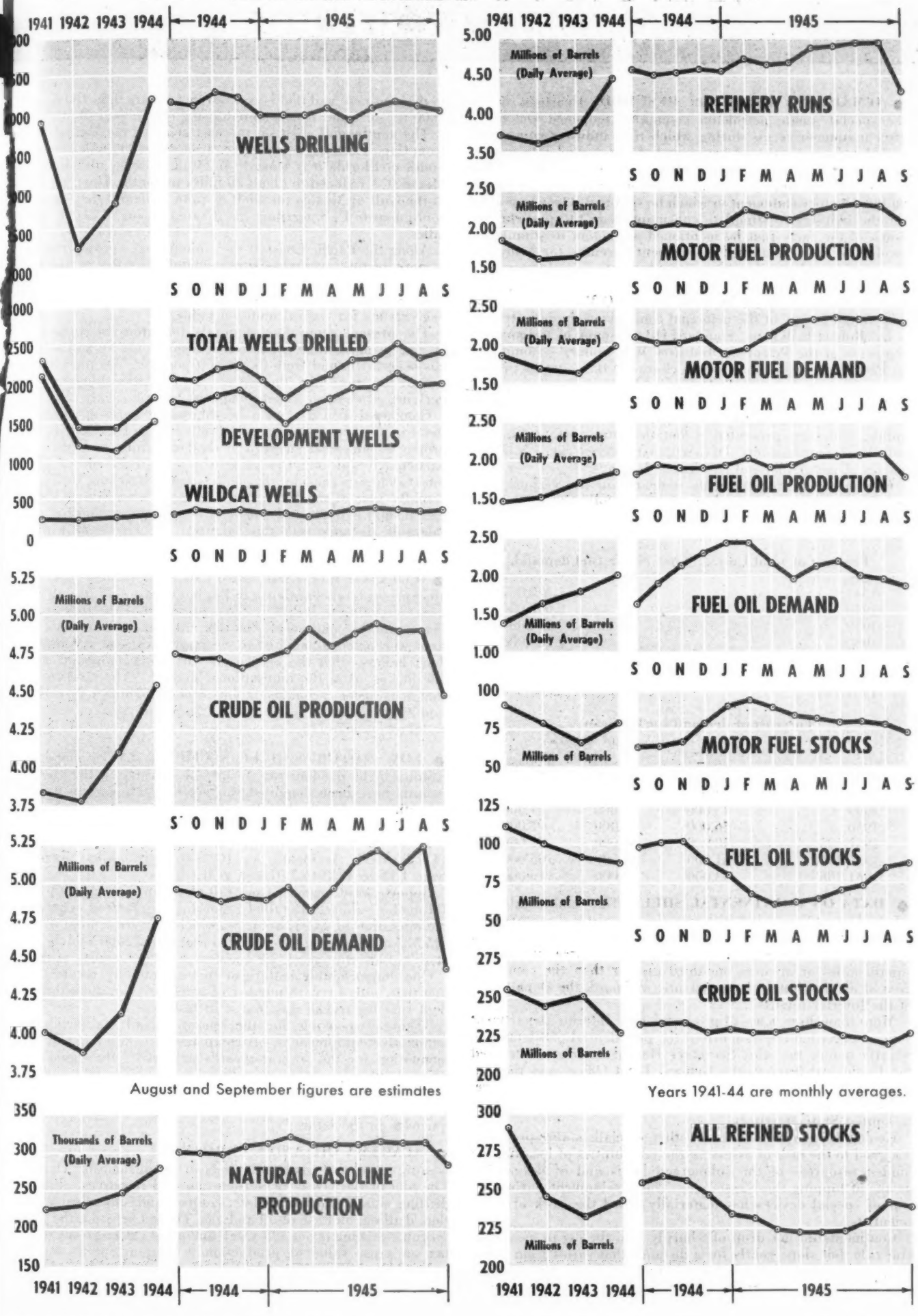
U. S. average	$1.22	Louisiana	$1.20
Texas	1.23	Arkansas	1.25
California	1.07	New Mexico	1.04
Oklahoma	1.17	Mississippi	1.10
Kansas	1.17	Illinois	1.37
		Other states	1.89

Basic crude prices	
Oklahoma-Kansas (36 gr.)	$1.17
Texas Gulf Coast (36 gr.)	1.40
East Texas	1.25
West Texas (36 gr.)	1.04
Calif. Signal Hill (26 gr.)	1.11
Pennsylvania Bradford	3.00

Drilling and Production Statistics by States

	Sept. 1945	August 1945	Sept. 1944	This year to date	Last year to date	Per cent change
Total wells drilled	2,423	2,346	2,060	20,082	16,062	+ 25
Texas	599	595	516	5,313	4,121	+ 29
California	152	206	167	1,719	1,452	+ 18
Oklahoma	231	191	200	1,824	1,251	+ 46
Kansas	166	158	152	1,281	1,347	— 5
Louisiana	115	85	77	837	568	+ 47
Arkansas	14	16	11	125	218	— 43
New Mexico	28	29	27	305	290	+ 5
Mississippi	36	34	17	274	98	+180
Illinois	184	177	175	1,321	1,304	+ 1
Other states	898	855	718	7,083	5,413	+ 31
Wildcats drilled	366	339	318	3,076	2,821	+ 9
Texas	124	119	120	1,176	1,020	+ 15
California	16	24	7	178	150	+ 19
Oklahoma	42	52	45	354	274	+ 29
Kansas	28	36	37	281	372	— 24
Louisiana	14	12	10	130	95	+ 37
Arkansas	4	0	1	29	47	— 38
New Mexico	10	9	5	60	50	+ 20
Mississippi	9	16	8	97	64	+ 52
Illinois	41	32	20	269	262	+ 3
Other states	78	39	65	502	487	+ 3
Daily crude production	4,467	4,887	4,766	4,787	4,537	+ 6
Texas	1,849	2,212	2,170	2,139	2,012	+ 6
California	869	919	888	914	842	+ 9
Oklahoma	388	388	350	378	335	+ 13
Kansas	262	268	270	267	271	— 1
Louisiana	356	350	354	355	353	+ 1
Arkansas	77	79	81	80	80	0
New Mexico	102	102	105	104	109	— 5
Mississippi	54	53	46	51	43	+ 19
Illinois	200	207	209	206	213	— 3
Other states	310	309	293	293	279	+ 5

§No change since prices frozen. Prices do not include subsidies.
(p) Preliminary. ***Does not include input wells.



August and September figures are estimates

Years 1941-44 are monthly averages.

Highlights IN OILDOM

● **O'MAHONEY HEARINGS RESUMED.** Hearings before the special senate petroleum committee reopened October 3 after a summer recess during which time industry committees completed preparation of testimony to be presented on a number of subjects during the coming weeks. Senator Joseph C. O'Mahoney of Wyoming, chairman, presided at the hearing and made an introductory statement in which he said that it was important for the industry to stimulate consumption in the postwar era. Some of the facts that he mentioned as factors in stimulating production were continued government purchase for Army and Navy service, shortening of working hours to provide more leisure time in which people could use automobiles, and building of modern homes using oil burners. Senator O'Mahoney said that this would be one of the principal concerns of the industry.

Dr. Robert E. Wilson, Standard Oil Company of Indiana and chairman of the Petroleum Industry War Council's Committee on Petroleum Economics, was in charge of the industry presentation. He introduced S. P. Coleman, director of the co-ordination and economics department of Standard Oil Company (New Jersey), who testified at the morning session of the committee. Coleman presented a detailed statistical picture of petroleum requirements. Of particular interest were his summaries of motor fuel and lubricants demands.

Combining all requirements indicated in the various categories enumerated in the foregoing, the following immediate postwar and long-term total demands for motor fuels and lubricants are derived:

Forecast of total United States motor fuel demand.

Period	Daily average, bbl.
1947	1,870,000
1948	2,040,000
1949	2,150,000
1950	2,220,000
1951-1955	2,290,000
1956-1960	2,500,000
1961-1965	2,660,000

Forecast of demand for lubricants.

	Daily average in barrels		
Period	Automotive and aviation	Industrial	Total
1947	41,000	44,000	85,000
1948	43,000	46,000	89,000
1949	45.000	46,000	91,000
1950	46,000	46,000	92,000
1951-1955	48,000	49,000	97,000
1956-1960	51,000	54,000	105,000
1961-1965	53,000	57,000	110,000

● **DATA ON CONTINENTAL SHELF.** The continental shelf off the United States and its territories, the natural resources of which have been placed under United States jurisdiction by a proclamation of President Truman, has an area of 750,000 square miles or an area one-third greater than the combined area of all the States of the Atlantic seaboard, the Department of the Interior reports.

More than three years of preparation by Interior Department experts preceded the issuance of the presidential proclamation. Shortly before the war, Secretary Harold L. Ickes instructed the Geological Survey, the General Land Office, and the Bureau of Mines to undertake investigations concerning the resources of the submerged portions of the continent contiguous to United States territory.

Geologists, geophysicists, and other specialists were promptly assigned to the task of assessing the possibilities of locating the hidden resources of the submerged lands and of developing means of tapping those resources. The development during the war of special devices has materially aided the work of these scientists.

Continents do not drop off sharply into the ocean as a general rule, but slope gently for a distance that varies from a few to several hundred miles before the real depths of the oceans or seas are reached. Generally submerged land that is contiguous to the continent and that is covered by no more than 100 fathoms (600 ft.) of water is considered as the continental shelf.

The continental shelf on the east coast of the United States from Cape Hatteras north ranges from 60 to 250 miles in width. South to Florida it is from 40 to 60 miles wide, although near Miami it is reduced to about 20 miles in width. Along the coast of the Gulf of Mexico the shelf is quite wide and that part of it contiguous to U. S. territory has an area of some 149,000 square miles.

Along the Pacific Coast of the United States proper the shelf is more narrow, averaging approximately 25 miles in width and varying in width from one mile to as many as 50. Off Alaska the shelf widens considerably and under the waters of the Bering Sea extends for several hundred miles.

The present shore line is purely fortuitous in its position. During geologic time it has stood at many places and at times has been far inland from its present position. The present position of the shore line, therefore, has no relationship to any underlying oil or other mineral deposits.

Compared with its extent in some other parts of the world, the area of the continental shelf adjacent to the United States proper is somewhat small. The shelf off China and Malaya is particularly wide as is that off northern Australia and off Argentina. Geologists consider that both Great Britain and Ireland are actually part of the European land mass, and Europe's continental shelf extends under most of the North Sea and for a considerable distance into the Atlantic. The continent with the smallest submerged area is Africa.

● **PLEASED WITH OIL CONFERENCE.** Results of the Anglo-American oil conference in England are good for both countries, according to Ralph T. Zook, president of the Independent Petroleum Association of America, and one of four oil executives who acted as adviser to Secretary Ickes at the meeting. Zook believes that the agreement will bring about an orderly offering of oil in the international market. "The new commission will make recommendations, not hand down directives," said Zook. Complete text of the Anglo-American agreement will be found on page 176.

● **LOW MOTOR-VEHICLE ACCIDENT RATE.** The lowest motor-vehicle accident rate in the oil industry in the 13 years records have been compiled was set in 1944, despite wartime operating conditions, the Department of Accident Prevention of the American Petroleum Institute has reported.

Accidents per 100 vehicles decreased from 15.5 in 1943 to 14.1 in 1944, Accidents per 100,000 vehicle-miles decreased from 1.14 in 1943 to 1.01 last year.

Reports were received from 170 oil companies operating 53,198 motor vehicles. Detailed reports were received concerning the operation of 48,057 vehicles, which traveled a total of 652,515,522 miles during the year. On that basis, each vehicle operated had an average of one accident for 99,347 miles of travel.

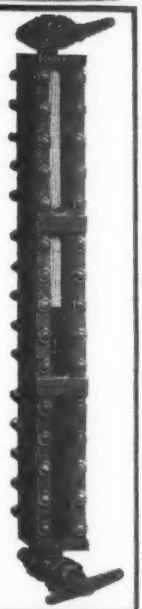
One commendable feature of this outstanding record is the fact that, with a record number of trucks in operation, the accident rate for trucks was lowest in history.

"Those responsible for the operation and maintenance of automotive equipment in oil companies are deserving of commendation for the several records achieved," the department pointed out.

"These records, made under difficult wartime conditions, constitute a challenge to those who will seek lower accident frequencies in the future."

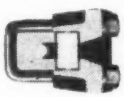
● **ALABAMA OIL AND GAS BOARD.** By an act of the legislature an oil and gas board has been established for Alabama. The aim of the law is to conserve natural resources, eliminate drilling waste, and to regulate, control, and supervise production, drilling, and use of oil and gas. The act creating the board sets up a drilling tax of $25 a well and a 2 per cent gross receipts tax on gross value of production. Governor Sparks has appointed the following as members of the board: Oliver Young, Milton Fies, and P. F. DeVane.

PENBERTHY
"REFLEX"
DROP FORGED STEEL
LIQUID LEVEL GAGES



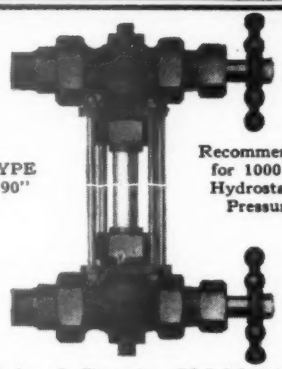
Liquid always shows black—empty space shows white. Preferred where the liquid level must be easily and positively visible, and when liquids are under high pressure or at high temperature. Made of alloy temperature resisting steel and are highest quality throughout. Liquid chamber made from solid block of steel to assure perfect alignment and rigidity. Conform with A.P.I.—A.S.M.E. requirements.

The "Reflex" is one of the complete line of Penberthy Gages that meet every liquid level gage requirement.



PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

PENBERTHY
DROP FORGED STEEL
LIQUID LEVEL GAGES



TYPE "90"

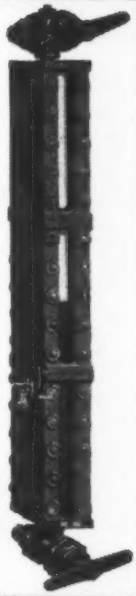
Recommended for 1000 lb Hydrostatic Pressure

Made of Chromium-Molybdenum alloy temperature resisting steel, extra heavy throughout and stainless steel trimmed. Positive automatic shut-off; stainless steel balls shut off the flow of liquid if glass breaks. Regrinding removable seats, heavy duty stuffing boxes, union connections. Conform with A.P.I.—A.S.M.E. requirements.

This is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

PENBERTHY
"TRANSPARENT"
DROP FORGED STEEL
LIQUID LEVEL GAGES

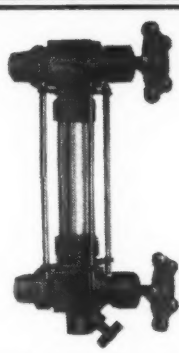


Used to observe color and density of liquids under high pressures and/or temperatures. Construction exceptionally sturdy. Made of alloy temperature resisting steel, and are highest quality throughout. Liquid chamber made from solid block of steel to assure perfect alignment and rigidity. Conform with A.P.I.—A.S.M.E. requirements.

The "Transparent" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

PENBERTHY
"ALL IRON"
LIQUID LEVEL GAGES

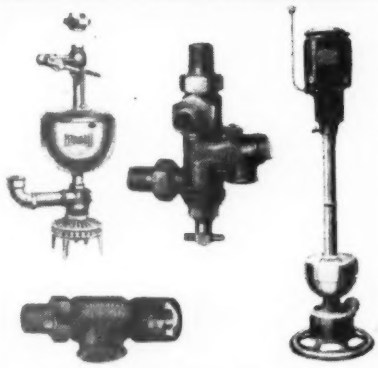


Body made from a special high strength alloy iron, shanks alloy steel and trim stainless steel. Extra heavy construction throughout, automatic and positive shut-off if glass breaks, heavy duty stuffing boxes. Conform with A.P.I.—A.S.M.E. requirements.

The "All Iron" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

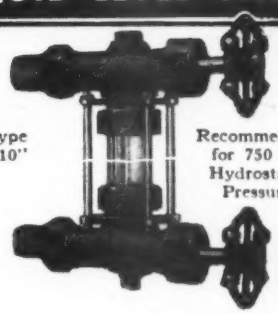
PENBERTHY
QUALITY
PRODUCTS



Penberthy injectors—ejectors—automatic electric and water (or steam) operated sump pumps are all widely used throughout the oil industry because they have always been dependable under the most severe service conditions.
All are of rugged construction and made by an organization with 59 years experience in the manufacture of highest quality products.

PENBERTHY INJECTOR CO.
DETROIT 2, MICH. Canadian Plant WINDSOR, ONTARIO

PENBERTHY
DROP FORGED STEEL
LIQUID LEVEL GAGES



Type "10"

Recommended for 750 lb. Hydrostatic Pressure

Steel construction throughout with stainless steel interior trim. Automatic shut-off is positive and instantaneous; stainless steel balls shut off the flow of liquid when glass breaks. Heavy duty stuffing boxes, union connections, offset construction facilitate cleaning and simplify glass replacement. Conform with A.P.I.—A.S.M.E. requirements.

This is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

MAJOR *Oil Field* ACTIVITIES

● **NEW MEXICO.** Penrose No. 1 Federal-Penrose, Lea County, is an Ellenburger discovery 25 miles north of the nearest production from that formation. It had an initial production of 667 bbl. of 40.6-gravity oil from 8059-89 and 8100-40 ft. The project went to 8370 ft. in granite before being completed in the Ellenburger.

A lower Permian discovery is the DeKalb No. 1 Elliott. Two miles south of the initial producer in the Drinkard field from the Clear Fork, Lea County, the well was completed for 402 bbl. of high gravity oil in 17 hours flowing from open hole from 6814-6995 ft.

Discovery well for the North Roberts pool is the McLaughlin and Cosden No. 1 State, Lea County. The well pumped 125 bbl. of 37.2-gravity oil on initial tests. Production is from 4004-4385 ft.

● **MICHIGAN. The most promising wildcat oil strike in Michigan this year has been made by L. T. Barber and Union Drilling Company. The well is the Gyger No. 1 in Montcalm County. It averaged 15 bbl. of oil an hour on tests. Production is from the Dundee, 3391-97 ft. The discovery is 5 miles north of a shallow gas field and 12 miles southwest of the old Crystal oil field.**

● **OKLAHOMA.** The Dale pool in northwestern Pottawatomie County has been opened by L. B. Jackson and Deep Rock Oil Corporation with No. 1 Rose. Total depth is at 5812 ft. The well showed production possibilities in the Wilcox. Some field men say it looks like a potential 350 to 500-bbl.-a-day producer.

No. 1 Jirick of Phillips Petroleum Company and Carter Oil Company is a good producer in the Bois d'Arc pay zone to open a pool in Kingfisher County, Oklahoma. The well is 5 miles from the West Edmond field, but is considered a pool opener because of its structural position. Drilled to 7393 ft. in the Sylvan shale, the well is perforated from the top of the Hunton lime section at 7064-94 ft. It flowed 629 bbl. of 40-gravity crude in 24 hours. Gas ratio is 1420 cu. ft. to 1 bbl.

Pontotoc County has a pool opener with Norbla Oil Company and British American Oil Producing Company No. 1 Carr. A. wildcat southwest of the Bebee pool and within several miles of the Garvin County line, the well produced on initial tests from 3 different zones of the Trenton lime at 1350 ft.

The Texas Company No. 1 Holt, shallow oil pool opener in Jackson County, pumped 51 bbl. of oil in 15 hours from 1419-33 ft. The wildcat in the southwestern corner of the state, is still testing.

J. E. Trigg and associates No. 1 Tennery, wildcat test, is overshadowing all other wildcatting in Oklahoma with its good gas showing in the dolomite just above the second Wilcox sand. At a total depth of 10,731 ft., 105 ft. in the second Wilcox sand, the test was abandoned. It had an estimated 2,000,000 to 3,000,000 cu. ft. of gas and indicates that oil and more gas reserves may be near. The test is in Canadian County.

● **TEXAS.** Sun Oil Company has opened its second gas condensate pool in the Rio Grande Valley with No. 5 Sullivan in Brooks County. The discovery made 24 bbl. of condensate and several million cubic feet of gas daily through casing perforations in the pay section, 7831-39 ft. Carried to 9927 ft., the lower sections failed to produce and the well was plugged back for completion. The discovery is several miles southwest of the Dan Sullivan pool.

A new Ellenburger, lower Ordovician oil pool for northwestern Archer County, Texas, has been opened by Manning and Brown, Inc. It is No. 1 Nochols. Initially the well flowed 169 bbl. of 44.6-gravity oil in 10 hours from the Ellenburger at 5474 ft. The well indicates a possible sizable structure in that part of the country.

Austin County has a new pool opener with Sinclair Prairie Oil Company No. 1-A Schweke. Located in the upper Gulf Coast 2 miles southwest of the townsite of Ulm, the discovery was completed to flow 117 bbl. of 34.6-gravity oil in 24 hours. The producing zone is from 9155-65 ft. This is the lowest gravity oil yet found on the Wilcox-Jackson trend and is expected to stimulate increased development in the particular section of the geological feature.

Deepest oil production in the Permian Basin has been discovered in West Texas by Amerada Petroleum Corporation. The wildcat is the No. 1-A Dr. E. H. Jones in Gaines County. Initially the well flowed 899.74 bbl. of 42.7-gravity oil in 12 hours between 11,380-420 ft. with total depth at 11,635 ft. The well also indicated production from the Wolfcamp, basal Permian.

Six miles east of Olney, Young County, Kerlyn-Phillips No. 1 W. E. Edwards has been completed as a producer. The wildcat was drilled to 5106-13 ft. in the Mississippian and flowed natural 130 bbl. of oil in 5 hours through 2-in. casing. It has been shut in for further testing.

Montague County has a new wildcat producer with A. R. Dillard No. 1 Dr. J. T. Lawson. In the conglomerate at 5993-6001 ft., the well showed gas in 2½ minutes and began flowing oil in 29 minutes. Operators will drill a little deeper. This opens a big new area of undrilled lands.

Etex Oil, Lt., has completed its No. 1 Martin in Concho County as a producer to open the first pool for the county. The well is 4 miles northwest of Eden and 40 miles southeast of San Angelo. It made 648 bbl. of 44-gravity oil daily from 3801-09 ft. in the Pennsylvanian.

● **ILLINOIS.** A new commercial oil area for Clay County is indicated by J. J. Lynn and Pure Oil Company No. 1 Goings northwest of Clay City. The pay is the McClosky limestone. 3030-36 ft. On a drillstem test the recovery showed gas in 3 minutes and a natural flow of oil in 10 minutes.

A gusher well at North Mattoon may revive the oil play in southern Illinois. The Joe Cull and others No. 1 Craig had the Aux Vases sand at 1920-32 ft. where a drillstem test showed 400 ft. of oil in an hour. The well was cleaned out and shot from 1916-64 ft., flowed 102 bbl. of oil an hour for 2 hours and 600 bbl. in the next 11 hours.

● **KANSAS.** Helmerich and Payne, Inc., appear to be giving Kansas another big gas pool with the opening of No. 1 Peter Estate several miles north of the Morrison gas pool, eastern Clark County. The well showed, for what might be a definite test approach, 100,000,000 ft. of gas a day. Production is from the Mississippi line.

● **WYOMING WELL HAS GAS. The Pure Oil Company has found gas in a test well near Worland, Wyoming, according to company officials. Situated on a 21,000-acre lease, the well showed a substantial amount of gas at a depth of 7242-70 ft. The new producer is a considerable distance from proved reserves. The company will take the well to 10,000 ft. before completing it.**

● **KENTUCKY.** In Union County R. B. Martin and Central Pipe Line Company have opened a new pay zone in a well that has for 3 years produced from the McClosky limestone at 3137-41 ft. The well was completed in 1942 for 1500 bbl. of oil a day. Recently operators milled out the casing opposite the Cypress sand, 2846-61 ft., and the well flowed from that depth. Operators believe that the well should pump more than 120 bbl. of oil a day.

Ryan Oil Company has a possible pool opener in its No. 1 M. Greenwell and M. U. Pfeiffer community test located about a mile from the Uniontown oil pool. The drillstem test made on the Cypress sand found at 2342-50 ft. recovered 690 ft. of clean oil, 250 ft. of oil-cut mud, and 510 ft. of salt water. The electric log showed good saturation in the Cypress and informed sources estimate this well to be good for 100 to 300 bbl. of oil a day when completed. This well will create additional interest in the immediate area, oil men believe.

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Dowell Plastics seal any formation

Positive, permanent shut-off of unwanted water and gas from limestones, sandstones, dolomites . . . or from any combination of formations—is achieved by the use of Dowell Plastic Service. Dowell plastics have demonstrated their excellent penetrating and bonding properties in thousands of treatments in many fields.

Expert Dowell engineers, using latest equipment and techniques, have obtained these superior results because modern Dowell plastics solidify at the proper time and place. They are not affected by fluids encountered in the well, extremes of temperature, or the method of well completion.

Ask the nearest Dowell office for full information about Dowell Plastic Service for the control of troublesome gas-oil ratios and water-oil ratios—in *any* type of well. Ask also about Plastic Service in setting liners . . . correcting faulty cement jobs . . . shutting off water to save extra casing in cable tool drilling . . . bridging during selective acidizing . . . cementing casing . . . and in isolation squeeze work.

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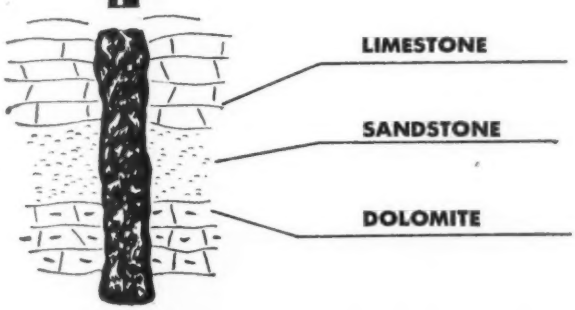

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MAJOR *Pipe Line* ACTIVITIES

● **FLOW REVERSED.** The flow has been reversed in the Keystone Pipe Line, extending from Philadelphia to Pittsburgh, Pennsylvania, and is now sending gasoline and other light products to meet civilian demands in its marketing area west of Harrisburg, according to Atlantic Refining Company. The Keystone artery was built to transport refined oil products westward. Before the war Atlantic received most of the crude oil needed at its Philadelphia plant by tankers from the fields of the Southwest. After Pearl Harbor the tanker fleet was turned over to the Government and Atlantic had to get most of its supplies by railroad tank cars and pipe lines. Early in 1942 the flow of the Keystone line was converted to bring this crude from the fields.

With the close of the war, pumps were relocated at the Philadelphia refinery and at the pumping station at Blue Mountain, all crude oil was cleaned from the line, and the artery was reconverted to refined products. The line is 8 in. in diameter and has a daily capacity of 25,000 bbl.

● **NATURAL GAS LINE.** FPC has granted to Central Illinois Public Service Company permission to construct and operate a 6-in. natural gas pipe line between Tuscola and Mattoon, Illinois. The carrier, approximately 20 miles long, will enable the company to obtain its natural gas supply directly from Panhandle Eastern Pipe Line Company to meet the requirements of its customers in the Mattoon, Illinois, area. The proposed 6-in. carrier will have a capacity in excess of 5,000,000 cu. ft. of gas per day. This, the company estimates, will be adequate to meet the now-anticipated requirements of Central Illinois through 1950. Towns served in the area include Paris, Kansas, Ashmore, Charleston, Mattoon, Neoga, Sigel and Effington, all in Illinois. Central Illinois will be able to reduce rates to its ultimate consumers in these communities because it will buy its gas supply from Panhandle Eastern at a substantially lower price than it pays Kentucky Natural Gas Corporation. FPC has dismissed an application of Kentucky Natural Gas Corporation for authorization to construct similar facilities for the purpose of augmenting the supply of natural gas sold to Central Illinois.

● **AIR PATROL. The McAllen, Texas, chamber of commerce is investigating a plan whereby pipe line gathering systems and main lines leading from Valley oil fields to refineries may be patrolled by air through the winter months. One of the largest oil companies owning its own line, has proposed a cooperative plan by which the pipe lines would employ discharged war veterans to watch over their lines. Oil men say that a patrol plane could cover as much territory in a day as several men now cover in a week.**

● **CHICAGO CORPORATION SELLS.** The Chicago Corporation has sold its interest in the Tennessee Gas and Transmission Company to a group headed by Stone and Webster, according to Richard Wagner, president of the Chicago company. Its interest in the 1265-mile West Texas-to-Virginia pipe line which was financed in 1944 to supply gas to the Appalachian industrial area, was sold by the Chicago concern for $10,500,000. Contracts with the Tennessee concern for sale to it of 90 per cent of its initial gas requirements run until 1970 and are not affected by the sale, Wagner said.

Transfer of its interest in the Tennessee company was for the purpose of avoiding a possibility that the Chicago corporation might be classified as a natural gas company by FPC because of its holdings in the pipe line company. Such a classification, if made, might have subjected the concern to requirements that would have interfered with its operations as an investment company specializing in supplying risk capital, it said.

● **RFC SUSPENDS LINES.** RFC has announced that operation of 5 government-owned pipe lines will be discontinued within a period to range from 30 to 60 days .The five lines are: The Big Inch, a 24-in. carrier from Longview, Texas, to Linden, New Jersey, a distance of 1245 miles; The Little Inch, a 1405-mile artery from Beaumont, Texas, to New York; The Florida Emergency Pipe Line, an 8-in., 200-mile line from Carabelle to Jacksonville, Florida; The Greensboro-Richmond Extension of the Plantation Pipe Line, from Greensboro, North Carolina, to Richmond, Virginia, a distance of 175 miles of 8-in. line; and The Southwest Emergency Pipe Line, 14-in. and 16-in. carrier from Corpus Christi, to Houston, Texas, a distance of 154 miles.

● **WISCONSIN LINE.** FPC has authorized the Wisconsin Southern Gas Company to build and operate facilities to serve southern Wisconsin communities in which it has state and local permission to sell natural gas. The Natural Gas Pipeline Company of America has been directed to extend its transportation facilities to connect with those of Wisconsin Southern at the Illinois-Wisconsin line near Genoa City and to sell gas to Wisconsin Southern for distribution.

● **SOUTHERN GAS FACILITIES.** Southern Natural Gas Company, Birmingham, Alabama, has been directed by FPC to construct 116 miles of pipe line in Louisiana, Georgia, Alabama and Mississippi. The company is also to build a 1200-hp. compressor station on its Montgomery-Columbus branch near Wetumpka, Alabama. The proposed new construction at a cost of about $3,771,760, will increase delivery capacity of the company from 220,000,000 cu. ft. daily to 245,000,000 cu. ft., FPC said. The company was also required to assure adequate deliveries of gas to its existing customers. The company operates a pipe line system from gas fields in Texas and Louisiana to Atlanta, Georgia, with branch lines to about 50 cities and towns in Alabama, Mississippi and Georgia.

● **TWIN LINES. Now almost complete is a $20,000,000 pipe line across the Isthmus of Panama. Originally planned to guarantee fuel supplies to the fleet should the Panama Canal have fallen victim to enemy action, the Navy says that the line proved so valuable and the needs of the Pacific fleet became so great, that the capacity of the artery was more than doubled by building a duplicate carrier before the first one was finished.** **See complete story on page 106.**

● **AGREEMENT REACHED.** Agreements have been approved whereby Standard Oil Company of California may build and operate a 26-in. pipe line from Saudi Arabia to Haifa, Palestine. H. D. Collier, president of Standard in making the announcement, said that the 1000-mile artery will have its Mediterranean terminus at Palestine. Standard and The Texas Company have leases on more than 200,000 square miles of Saudi Arabia, covering one of the richest oil reserves in the world.

● **HEARING POSTPONED.** FPC has postponed the hearing on the Metropolitan Eastern Corporation's application for authority to build and operate a pipe line from the Carthage Field, Panola County, Texas, to Hamilton, Ohio, from October 15 to January 15. The proposed carrier would be 18 in. in diam. and 825 miles long and would have a capacity of 140,000,000 cu. ft. of gas daily.

● **OUTLET FOR FIELD.** Ross Field in King County, northwest Texas, is being provided with a 4-in. line by Humble Pipe Line Company. The 4-in. carrier will connect with the company's 10-in. truck line from the Panhandle to the Gulf Coast.

● **STANDARD PLANS LINE.** Standard Oil Company of California will construct a 167-mile 18-in. natural gas line for the Pacific Power and Light Company. Work is scheduled to begin immediately on the line that will run from Bakersfield to Richmond, California.

Engineering feat

In a recent radio report from overseas it was revealed that army engineers had built a 20-mile pipe line in 27 hours. The line, from Yokahama to Atsugi air field, is used to bring gasoline to planes.

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MAJOR *Refining* ACTIVITIES

● **GASOLINE PLANT.** A 100,000,000-cu.-ft. gasoline absorption plant will be built in Carthage field, Panola County, Texas, by United Gas Pipe Line Company. The refinery will have a working pressure of 1050 lb. with a capacity to process condensate from an additional 50,000,000 cu. ft. Maximum working pressure of the plant will be 1200 lb. per sq. in. Downstream from the gasoline plant there will be a solid adsorbent-type dehydration plant having a capacity of 100,000,000 cu. ft. of gas per day at 1050-lb. working pressure. The company will install stabilization equipment to enable it to market propane, isobutane, butane, extracted gasoline, naphtha, motor fuel, kerosine, and residue. An 8500-gal. lead plant for adding tetraethyl lead to increase the octane of the motor fuel will be installed. A field laboratory will be located on the site and will be complete with a Podbielniak column and a gasoline octane testing unit.

The dehydration plant is expected to be completed by November 1 and the gasoline plant is scheduled for completion by December 15.

● **PLANTS LEASED. Five of the 23 government-owned 100-octane plants have been leased, according to RFC officials. They are Eastern States Petroleum Company, Houston, Texas; Ashland Oil and Refinery Company, Catlettsburg, Kentucky; Utah Oil Refinery Company, Salt Lake City, Utah; Continental Oil Company, Ponca City, Oklahoma, and Root Petroleum Company, El Dorado, Arkansas. The RFC has stated that a special rental deal will be made with these companies for a period while they experiment with these plants for motor gasoline production.**

● **ASPHALT REFINERY.** California Asphalt Corporation, a newly formed subsidiary of Standard of California, will build an asphalt refinery at Willbridge, Oregon, 6 miles northwest of Portland. Construction of the million-dollar plant will begin within the next few weeks. A complete operating unit in itself, the refinery will manufacture asphalt from crude oil shipped in tankers from California oil fields. Capacity of the unit will be between 4000 and 5000 bbl. a day. The finished product will be shipped from the refinery in tank cars and tank trucks and will be marketed in Oregon, Washington, and Idaho.

● **CHEMICAL PLANT.** Jefferson Chemical Company, jointly owned by American Cyanamid Company and The Texas Company, will erect a chemical plant adjacent to the Texas company's asphalt and roofing plant at Port Neches, Texas, according to H. L. Derby, president of Jefferson. Products to be made in the new plant will include intermediate chemicals for the manufacture of synthetic rubber, plastics, textiles, and other materials from petroleum and petroleum gases. The Port Neches site was selected, according to Derby, because of its proximity to The Texas Company's Port Arthur refinery, which will supply raw materials to the plant in the form of refinery gases. About 850 people will be employed in the construction that, company officials say, should take about a year. The completed plant will employ about 150 men and women.

Simultaneously with Jefferson's announcement came the word that American Cyanamid Company is consummating the purchase of about 900 acres immediately east of the Jefferson site and will erect a chemical plant utilizing some of the products manufactured by Jefferson.

● **CYCLING PLANT. Work has begun on the Rogers Lacy and Lone Star Producing Company cycling plant in the Carthage field of Panola, Texas. The plant will have a capacity of 50,000,000 cu. ft. of gas a day and will be situated 9 miles north of Carthage and a mile south of the Sabine River on the Carthage-Marshall highway.**

● **FOREIGN OPERATION.** Arabian American Oil Company, jointly owned by Standard Oil of California and The Texas Company, has begun operation of its new refinery at Ras Tanura, Saudi Arabia. The full capacity of 50,000 bbl. a day is expected to be reached by the end of the year. Capacity operation of the plant will bring total refining capacity of Standard-Texas subsidiaries in the Persian Gulf to 113,000 bbl. a day. Bahrein Petroleum Company, affiliate of Arabian American, doubled its capacity during the war years.

● **PLANT DELAYED. Delay of 60 days in beginning construction of a $5,500,000-absorption plant by Stanolind Oil and Gas Company at Hastings field, Texas, has been announced by Bill Keefer, field superintendent. The plant, designed chiefly as a conservation measure, will recover 35,000 to 40,000 gal. of liquid petroleum products daily on completion of the plant.**

● **PLANT ENLARGEMENT.** Standard Oil Company is undertaking one of the largest construction programs ever attempted at its refinery in Sugar Creek, Missouri, near Kansas City, according to a company announcement. Scheduled to proceed as rapidly as materials are available, the new facilities will include fluid catalytic cracking equipment with new features perfected by Standard for making especially high quality motor gasoline.

"The company has been very actively engaged during the war period in improving design and operation of its other catalytic cracking facilities used for production of 100-octane aviation gasoline," Dr. M. G. Paulus, vice president of Standard who made the announcement, said. "The knowledge and experience thereby gained will be used to the best advantage in constructing this tremendous new plant at Sugar Creek."

To be built on top of a bluff overlooking the present refinery on Missouri River bottom land, the main tower of the new cat cracker will rise 200 ft., or about the height of a 16-story building. A special feature of the new plant will be research and technical service laboratories and quarters for the engineering staff.

● **GERMAN PLANT HEAD. The former superintendent of Wisconsin Oil Refining Company who left his post in 1942 to go into the Army, Major John A. Crawford, has been named the first allied officer to be placed in charge of a refinery in Germany. Major Crawford heads the refinery at Misburg and is directing its reconstruction. He is also rebuilding another refinery at Bremen.**

● **CONOCO LEASES.** Continental Oil Company has reached an agreement with the defense plant of RFC providing for a 90-day lease of its 100-octane plant at Ponca City, Oklahoma. The $17,000,000-plant built by the government and leased to Continental, will be used by the company to make high-test motor gasoline. Negotiations are under way for a long-term lease or purchase of the plant, officials said.

● **CARTHAGE PLANT.** Construction has begun on a $3,000,000 high-pressure gasoline plant, one of the largest in the Southwest, by The Chicago Corporation in the Panola County, Texas, Carthage gas condensate pool. H. K. Greenleaf, executive vice president and Z. C. Ambrose, in charge of plant operations, say that the plant, which should be completed some time in 1946, will employ 75 men. The refinery will produce high-octane gasoline, will have complete stripping equipment, and a lead blending unit that will enable the production of leaded gas. Butane, propane, and I.T.G. will be produced. Other products also can come from the stripping plant.

The plant tank farm will be sufficiently large to provide a storage of products for a 30-day period. There will be six 5000-bbl. tanks and several 10,000-bbl. and 20,000-bbl. tanks. A spur railroad track will be built to provide an outlet from the plant and 2 generators will provide power for the camp site and project. The first building to be erected will be an office building. Preliminary work on this building has begun. The camp site will be built in the shape of a horseshoe.

FOREIGN NUMBER
THE Petroleum Engineer
OCTOBER, 1945
COLOMBIAN WILDCAT

Outlook for

By **K. C. SCLATER,** *Editor*

Brazil *Oil Well Supply Photo*

The stirring of renewed oil activity is felt from the land of palms to the land of snows and 'round the world.

Alaska

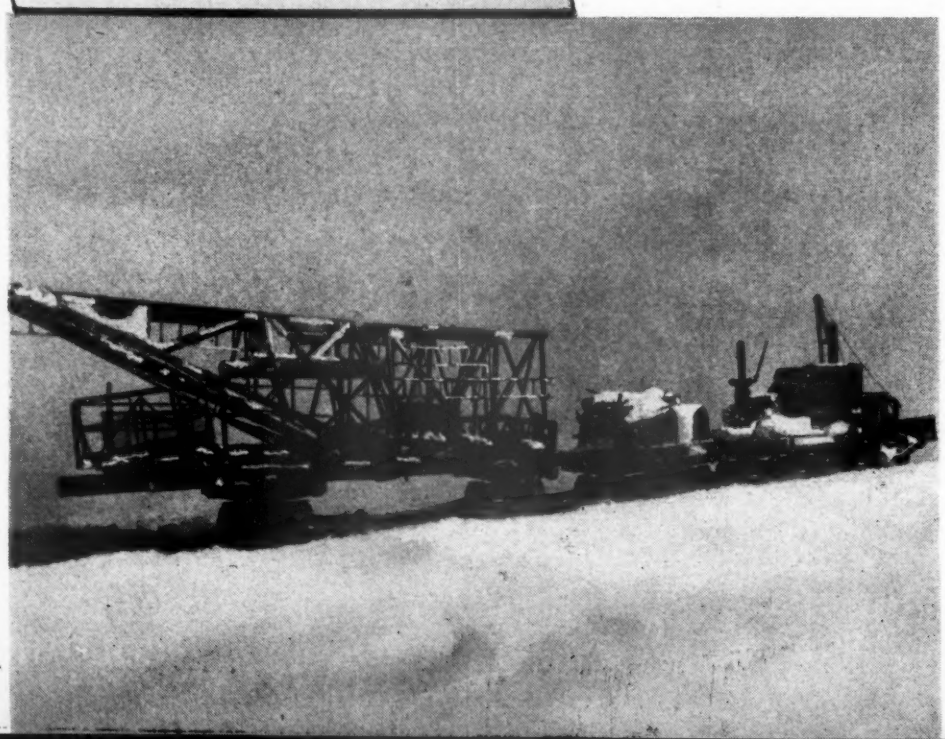
SIGNING of the revised Anglo-American Petroleum Agreement may be the signal heralding a new era in foreign oil development. The Agreement can be the forerunner of a beneficent and effective instrument for bringing about a better understanding, appreciation, and solution of the problems confronting oil-producing and oil-consuming countries of the world.

EXCLUSIVE

When the Agreement comes into force, a means will be provided for the discussion and possible means of settlement of difficulties arising in international petroleum trade. If this objective is accomplished, it will be a big step forward in promoting good international industrial relations.

Agreement Provides for Commission

As for the revised Agreement itself, it was signed on September 23, 1945, at London, England, and is preliminary to the formulation of a multi-lateral international oil agreement that it is hoped will eventually include all the oil producing and consuming countries of the world. It provides for the appointment of an international commission composed of six members, three from each of the signatory powers.



Acme Photo

Foreign Oil Operations

After the agreement is ratified by both governments and put into force the international commission is expected to meet and begin to function in an advisory capacity. It will have no power to impose regulations. In this respect the International Oil Commission will parallel the Oil Compact Commission of the United States, serving as a forum for the discussion—and a probable means for amicable settlement—of problems arising in international petroleum trade.

Mutual benefit must accrue to both the country and the company operating in foreign fields, and it is expected that this point will be strongly stressed in all future foreign oil operations. It might not be too much to expect that all foreign oil operations will eventually fit into a pattern that will conform with the most efficient and advanced practices known. Economically, politically, and from the point of view of world security, petroleum is now so important in world trade that, as some one has so aptly stated, it "must be removed from the arsenal of economic warfare."

Other broad problems might well be on the agenda for discussion and consideration by the International Oil Commission if the purposes of the Oil Agreement are to be fulfilled. The elimination of such problems as extreme tariffs and unreasonable and uneconomic trade restrictions would make for the smooth functioning of international petroleum trade. It has been said that "free enterprise is the counterpart in the economic field, of democratic action in the political field."

International oil policy should be directed toward national needs and not toward protection of special groups.

According to the purposes of the Oil Agreement, a paramount consideration in international oil trade is that there be an equitable distribution of world oil resources among all nations. Oil concessions that exclude nations needing oil from nearby sources are a threat to world peace.

Rehabilitation Hampered at Present

An immediate task faced in foreign oil operations is the rehabilitation of producing and refining facilities in the countries devastated by war. Due to the confusion inherent in the aftermath of war, this work may be slow in getting under way. Because of the temporary surplus of world crude supply brought on by the sudden ending of hostilities, repairing of damaged facilities may be considered less urgent than more pressing monetary problems. This is to be expected, for financing the purchases of equipment and supplies to replace and put into operation foreign oil facilities damaged by war involves many formidable problems that must have prior attention.

War has all but brought financial prostration to Russia, France, and Britain, and means must be found for financing purchases of necessary equipment and materials required by those countries. Until such time as suitable credit arrangements are worked out, the postwar program for the rehabilitation of world oil facilities is likely to encounter many difficulties and delays.

War Damage Extensive

Assessment of the war damage to foreign oil facilities is still under way and the full extent of the destruction wrought may not be known for several months.

One aspect of war damage, though it may not be generally regarded as such, is that in the United States many oil fields were produced at rates far beyond what was considered good practice, thereby reducing the ultimate volume of oil that would have been produced.

During the war refining facilities were increased in many parts of the world, particularly in the Middle East area surrounding the Persian Gulf. Venezuela, South America, also has had a sizeable increase in refining capacity; in addition, its crude production capacity has almost doubled during the war.

Oil companies operating in Venezuela are now required to refine ten per cent of their production in the country, thus ensuring a supply of refined products for the home market. This has led to the making of plans for the construction in Venezuela of large modern refining plants that include catalytic cracking.

During the war Argentina has been cut off from supplies of American equipment. Although little information is available regarding Argentina's postwar plans it is known that it will engage in more extensive drilling and refining operations when equipment and materials become available.

All oil countries in South America, because of the absence of monetary difficulties such as confront Russia, France, and Britain, will witness intensive drilling, production, and refining activity in the postwar period and just as soon as equipment and materials become available.

France Must Rebuild Plants

Almost all refining equipment in France will have to be rebuilt. Before the war France had some twenty or more small refineries and all produced low-grade products. A French official has proposed that postwar oil refining operations be consolidated in six modern plants, each of 50,000 to 75,000 barrels capacity and provided with the very latest in processing equipment. If such a plant were carried through it would mean the purchase of entirely new equipment.

Financial arrangements for the purchase of equipment by France from this country will probably be a factor in the rate

at which refining facilities are installed. This is sure to be the case if France has to rely on American companies or the American Government for its financing needs.

A substantial loan to France has already been approved, and refinery equipment will be among the goods and services to be bought in America as a result of this loan. Rehabilitation of refining facilities in France may not be carried out all at once. All industries, including petroleum refining, will be restored gradually as national needs dictate.

According to the reports of competent observers, about 40 per cent of the equipment in all the European refineries was totally destroyed, and 15 to 20 per cent was severely damaged but is repairable.

Present refining production in France is only about ten per cent of what it was before the war, but France still has a source of crude oil equal to her prewar imports. The problem is to transport it from Iraq. Iraq supplied 50 per cent of France's crude oil needs, the United States 40 per cent, and South America—mostly Venezuela oil—10 per cent.

Destruction in East Indies Complete

Reports from the East Indies indicate that destruction of equipment has been more severe there than anywhere in Europe. Standard Oil refineries in the East Indies are reported to have been almost completely demolished before capture by Japan. Repair and replacement of refining facilities are therefore likely to entail an extensive postwar construction program.

Large expansion programs in drilling, production, and refining are planned for the Middle East, especially in Saudi Arabia, where potential petroleum oil reserves are among the largest in the world.

Little information is available regarding Soviet Russia's postwar plans for petroleum development, or what damage its plants have suffered. Construction of petroleum facilities—which it is assumed will be quite extensive—will probably be contingent on credit and loan arrangements.

New Plants Will Be Modern

Replacement of equipment in war devastated oil areas will provide an opportunity to install modern equipment and adopt the latest and most efficient oil refining processes and production practices. Because of entirely new postwar conditions in these areas, past performances and experience may well become obsolete when measured in the light of modern technical advancements.

In those countries devastated by war, oil operations for a time will be concerned with the rehabilitation of producing and refining facilities rather than with new exploration and field development and the installation of new plants. Oil companies in other foreign fields will also be concerned with problems involving drastic changes in refining processes and product needs, increased competition from other countries, and the need for new designs of equipment.

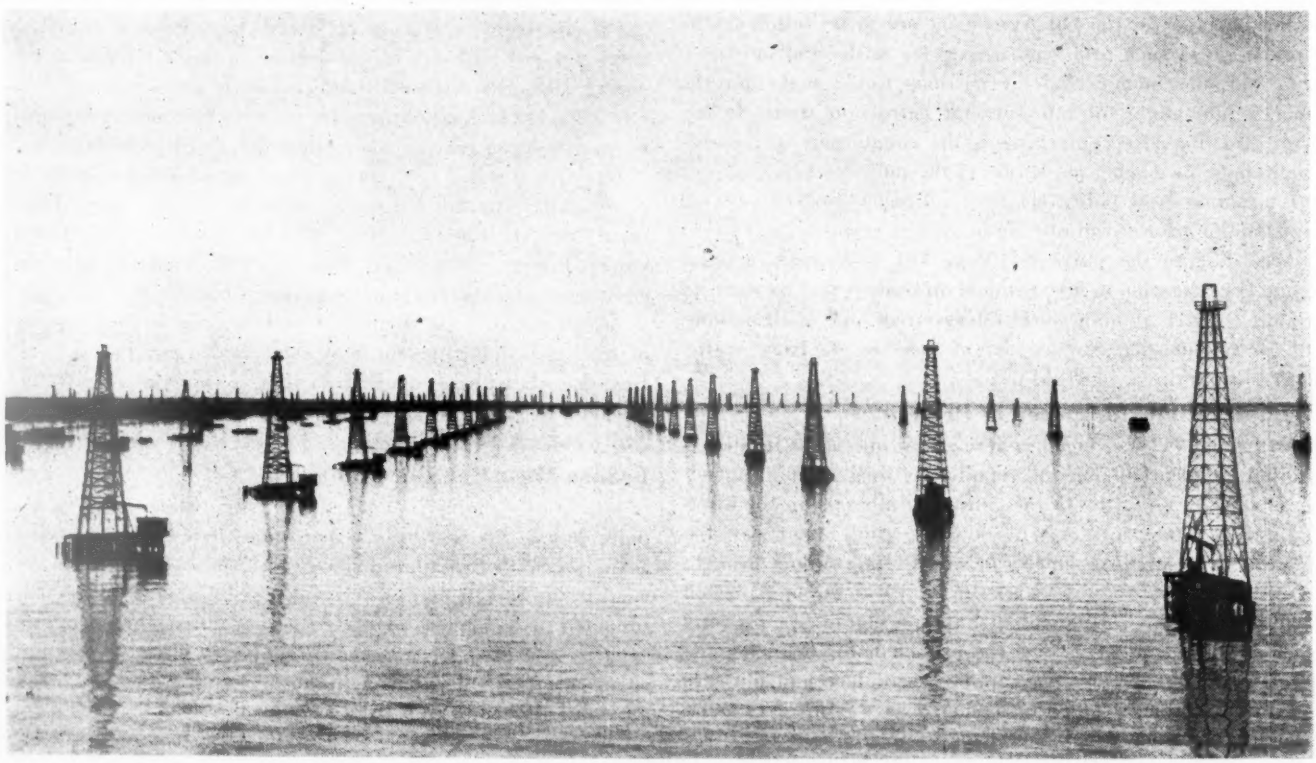
Exploration to Come Later

Disregarding the immediate difficulties that lie ahead, intensive exploration and drilling activity in foreign fields is in prospect. If the rate of discovery of new oil reserves in the United States continues to lag, large integrated oil companies may be compelled to depend more in the future on foreign production as a reserve supply for their market needs.

Cycling and repressuring operations will come in for more consideration in foreign fields in the future. Oil companies recognize the advantages to be gained by adopting secondary recovery practices and are expected to show little reluctance to unitizing, if necessary, their foreign properties for this purpose. It has even been suggested that foreign governments in their own interest may require oil companies to adopt recovery methods that will increase the ultimate economic recovery of oil.

★ ★ ★

Derricks lined up in water, too. Here they are strung across Lake Maracaibo. *Standard Oil Company (N. J.) Photo*



World Petroleum Outlook

By **H. J. STRUTH**

Petroleum Economist

EXCLUSIVE

War's end presents a reconversion problem for the world's petroleum industry that is expected, at least temporarily, to pose difficulties of a far-reaching nature. Any study of supply and demand for the first postwar readjustment period, which is 1946, cannot fail to reveal a decidedly unbalanced picture.

The world's demand for petroleum and its products in 1946 is apparently headed for a slump of perhaps 13 per cent below the war demand experienced in 1944. This means a probable decline in total requirements of more than 328,000,000 bbl. Estimates of the world's petroleum demand in 1944 indicate a total consumption of about 2,500,000,000 bbl. A country by country analysis of probable petroleum requirements in 1946 indicates a prospective demand of about 2,171,330,000 bbl.

The question before the world's petroleum industry next year is not how much of a reduction we may expect in demand, but how much oil will be produced? Herein lies the problem of reconversion of the world's petroleum industry. We have already seen the results of efforts to reduce output of crude oil in the United States, in response to greatly reduced domestic and war requirements. As far as the rest of the world is concerned, however, we cannot definitely foresee similar restrictive measures being applied to bring about a state of balance between supply and demand.

Many countries outside the United States, particularly those in Europe and in the Far East, will not be able to produce anywhere near the quantities of oil they produced prior to and during the war years. It will take at least a year or more to rehabilitate war-torn oil producing and refining countries. But, what about the vast sources of production in South America and the Middle East? Will those countries curtail the output of crude oil in conformity with reduced world requirements for petroleum products in the first postwar year of 1946? This is a question of paramount importance to the immediate welfare of the world's petroleum industry.

Obviously when production exceeds demand it becomes necessary either to cut back production or suffer depressed market prices for the folly of overproduction. Except in times of war, there is little need for storing large quantities of excess production anywhere in the world. As there is ample evidence at hand to indicate the necessity to effect a world-wide reduction in output of petroleum next year, it is logical to foresee some enforced curtailment in output of countries that have boosted their productive capacities to new high levels during 1944 and 1945.

Because there is as yet no machinery with which to prorate the world's oil production to conform with market demand, it becomes extremely difficult to set any pattern of what the world's oil production outside of the United States will be in 1946. After accounting for a definitely foreseeable reduction in output of the United States and some of the war-torn countries, however, it becomes necessary to assume either that South America and the Middle East will continue to produce oil at the 1945 rate, or that some necessary cut-backs may be made within the range of the yearly production rates established between 1940 and 1945.

Production to exceed demand in 1946— Surplus supply outside U. S. expected to be 416,000 bbl. a day.

On the foregoing assumption, it is not unlikely that the net reduction in output of the United States in 1946 will be about 815,000 bbl. daily. If South America and the Middle East maintain output somewhere within the range of 1940-44, these countries may reduce their combined output next year to the extent of 225,000 bbl. daily. The rest of the world, including Russia and Europe and the Far East, probably will be unable to maintain 1944 production rates and likely will show a reduction in 1946 of about 132,000 bbl. a day. These reductions combine to a total of 1,172,000 bbl. daily for the entire world. This would call for a total reduction in the world's crude output in 1946 of 428,006,000 bbl. This would bring the world's total crude production down from 2,640,956,000 bbl. in 1944, to 2,212,950,000 bbl. in 1946. To this must be added about 119,350,000 bbl. of other petroleum liquids, which makes the world's total new supply of petroleum about 2,332,300,000 bbl.

On a daily average basis, the world's demand for petroleum and its products in 1946 is estimated at 5,949,000 bbl. whereas the minimum output expected next year by all countries of the world will be at least 6,390,000 bbl. This means that the world will have a surplus petroleum supply next year of at least 441,000 bbl. daily. If there is any reason to foresee a greater demand for petroleum throughout the world next year than is now apparent by the writer's studies, there is also a more likely doubt with respect to the writer's projected production figures for next year. If the 1946 world demand for petroleum and its products should exceed these estimates, there would still be a substantial surplus of supply, particularly in view of the possibility that production estimates of some countries may be exceeded to a substantial degree.

Table 1 presents a complete summary of the supply and demand outlook in 1946 for the principal countries of the world. Before discussing the details of the table, it may be well to make particular reference to possible surpluses that could be created next year by the maintenance of high production rates for certain foreign nations in 1946 and possible increases above the projected rates next year:

Country	Projected, million bbl.	Possible increase, million bbl.
Russia	250	25
Iran	85	40
Venezuela	240	35
Iraq	30	5
Saudi Arabia	8	10
Other South America and Middle East	363	15
Total	976	130

If production of the above nations exceeds the 1946 projection to the extent indicated, it is not impossible that the world's production next year might reach a total of 2,462,300,000 bbl. If no

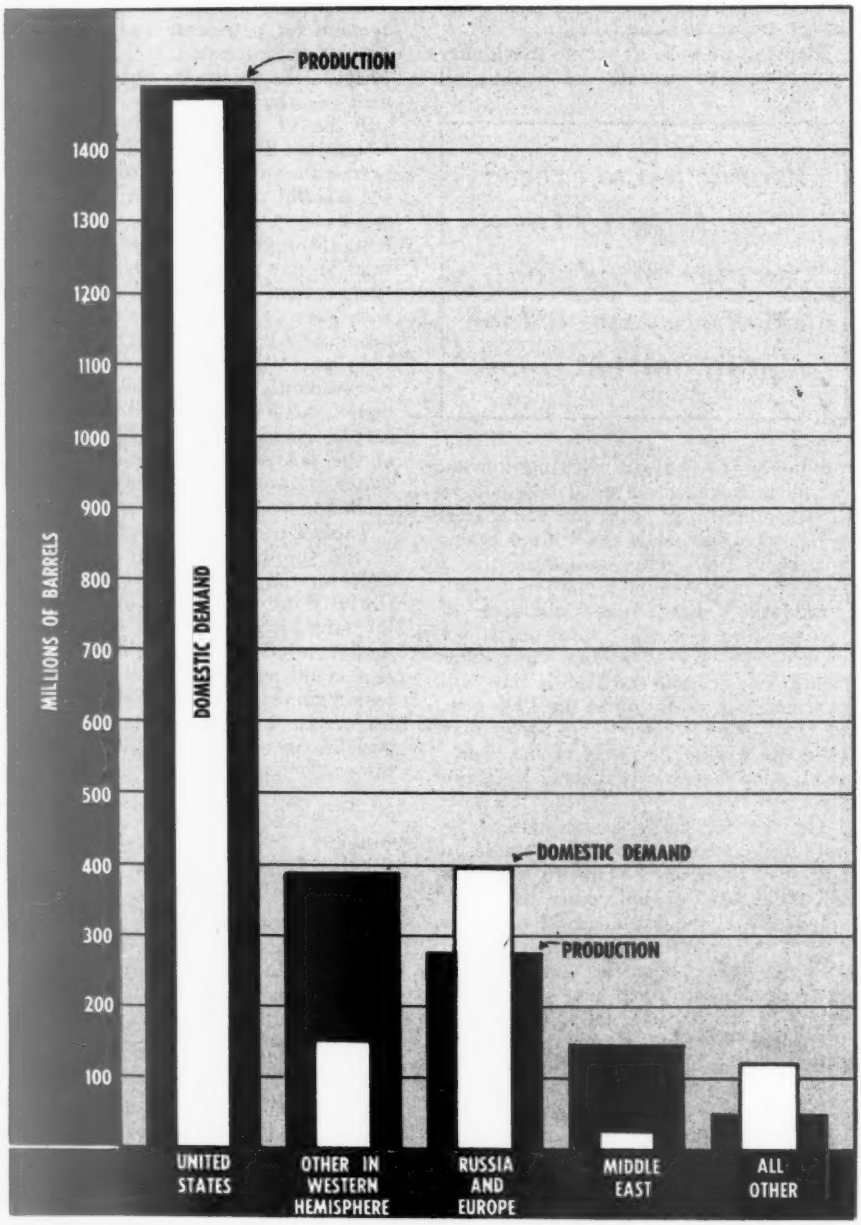
attempt is made to curtail output in these countries, it is evident that the world's surplus supply next year could attain a maximum of 800,000 bbl. a day, instead of 441,000 bbl., as forecast. By the same reasoning, any underestimate in the 1946 demand would leave a surplus of far greater proportions than has been indicated in Table 1.

Although the immediate outlook for the world's petroleum industry is beclouded by reduced demand and a definite oversupply in the world outside of the United States, studies of future requirements, following the first postwar year, present a decidedly favorable outlook. In fact, these studies indicate that 1946 will prove to have been but a belt-tightening period that will be followed by an unprecedented upturn in world demand for petroleum products. These studies indicate that even as early as 1948, the United States and the world will have experienced new peak demands that will exceed those established during the peak war year of 1944. This, the bright side of the petroleum industry's postwar outlook, will be discussed in detail in succeeding sections of this article.

The data presented in Table I represent the probable supply and demand outlook for the year 1946. Details for each country have been based upon the best available information and are believed to represent a fairly accurate picture for the world as a whole. It is conceded, however, that some of the demand estimates, particularly for former Axis nations, are more or less conjectural. In a number of these nations it was deemed advisable to project requirements for the first postwar year at bare minimums in keeping with extremely chaotic conditions resulting from the war. In most instances, the basic consideration in computing petroleum requirements was the number of motor cars and trucks in use and the ratio of all other products to motor fuel requirements. Heavy requirements for kerosine and lubricants in some countries that have experienced severe disuse of motor vehicles during the war account for greater than normal ratios of all other products to motor fuel consumption. It was found that the ratio of other products to motor fuel used by cars and trucks in the United States for 1946 will be about 2.8. In the rest of the world, the ratio is 4.1. This ratio for the rest of the world is expected to drop to about 3.5 by 1950.

FIG. 1
Probable petroleum production and domestic requirements, major areas of world, year 1946.

Black columns represent petroleum production, crude oil and other petroleum liquids. White columns represent domestic petroleum requirements. Surplus or shortages are indicated by height of white columns in relation to production.



The United States consumes more motor fuel per passenger car than any other nation, but the average consumption of all units, cars, trucks, and buses by some nations is considerably above the average for the United States, which is placed at 17 bbl. per motor vehicle in 1946. In British India, for example, where only 18 per cent of the motor vehicles are passenger cars, the consumption per unit is 41.8 bbl. Likewise, in Japan and Taiwan, where passenger cars only constitute 29 per cent of all motor vehicles, the average consumption is 38.2 bbl. Obviously, trucks and buses use considerably more motor fuel than passenger cars. Yet, the average consumption of motor fuel per vehicle for the entire world is 16.7 bbl., whereas the average of all countries outside of the United States is shown to be about 16 bbl.

The entire world is severely short of motor vehicles, which reached their lowest level this year. This leaves room for but moderate improvement during 1946 and must result in substantially reduced gasoline consumption everywhere in the world. Brazil has about 219,000 motor vehicles, but the consumption per unit there is next to the lowest in the world, only 10½ bbl. Many passenger cars and trucks in Rio De Janeiro, for example, are motivated by a charcoal furnace and use no gasoline at all. After the year 1946, when more motor vehicles are made available to Brazil and other South American countries, the continent to the south will perhaps see the greatest demand for petroleum in its history. All South America is waiting for new cars and new industrial engines. When these are made available, the demand for petroleum products in all South and Central America will greatly reduce production surpluses which may now exist.

Fig. 1 presents a graphic story of the world's petroleum supply and demand situation in 1946. The United States is expected to produce a total of 1,488,000,000 bbl. and consume 1,478,815,000 bbl., leaving a surplus of only 9,185,000 bbl. or 25,000 bbl. daily. The Western Hemisphere, outside of the United States, may produce 384,850,000 bbl. and consume 152,320,000 bbl., leaving a surplus of 232,530,000 bbl. or a daily

average of 637,000 bbl. Russia and Europe are expected to produce 277,900,000 bbl. and consume 397,700,000 bbl., creating a shortage of 119,800,000 bbl. or a daily average of 329,000 bbl. The Middle East may produce at minimum a total of 141,700,000 bbl. and may only require for home consumption 21,505,000 bbl., leaving a surplus of 120,195,000 bbl. or a daily average of 329,000 bbl. The rest of the world will probably produce about 39,850,000 bbl. and consume 120,990,000 bbl., creating a shortage of 81,140,000 bbl. or a daily average of 222,000 bbl. The net result is a surplus for the world of 160,970,000 bbl. or a daily average of 441,000 bbl.

Fig. 2 carries the conviction more forcibly that the surpluses of production of the principal countries of the world overshadow the shortages of the "have not" countries. Table 1 shows the pluses and minuses for each country. The minuses total 926,000 bbl. a day, but the pluses amount to 1,367,000 bbl. daily. The following data rank the prospective pluses and minuses of the countries of the world during 1946: (Figures are thousand barrels daily)

Surplus

Venezuela	634
Iran	208
Russia	123
Iraq	76
Colombia	61
Trinidad	48
Mexico	44
Peru	35
Netherlands East Indies	32
United States	25
Saudi Arabia	21
Bahrein Island	20
Rumania	14
Sarawak	14
Sakhalin	4
Egypt	4
Hungary	3
Poland	1
Total	1,367

Shortage

United Kingdom	164
Canada	106
France	98
Germany	70
Japan-Taiwan	66
Australia	43
Union of South Africa	33
British India	37
Brazil	23
Sweden	21
Argentina	16
Spain	15
New Zealand	13
Burma	1
All Other	220
Total	926
Total surplus	1,367
Total shortage	926
Net surplus	441

Reserves of crude oil in the United

TABLE 1—World petroleum supply and demand outlook—year 1946.

All figures are thousands except where otherwise indicated

Country	Crude oil produced	Other Pet. liquids produced	Total petroleum produced	Motor vehicles Reg.‡	Per cent Pass. cars.	Annual bbl. Cons. per unit	Automotive gaso. demand	All other Pet. Prod. demand*	Total petroleum demand	Surplus or shortage	Daily surplus or shortage
United States (Res. 20,500,000)	1,380,000 (D.A.3780)	108,000	1,488,000 (D.A.4077)	31,100	84	17.0	528,700	950,115	1,478,815 (D.A.4052)	+ 9,185	+ 25
Canada (Res. 150,000)	9,500	3,000	12,500	1,492	80	12.7	18,980	32,120	51,100	— 38,600	—106
Mexico (Res. 700,000)	38,000	500	38,500	178	63	16.8	3,000	19,300	22,300	+ 16,200	+ 44
Venezuela (Res. 5,700,000)	240,000	1,000	241,000	34	53	29.4	1,000	8,650	9,650	+231,350	+634
Brazil	500	..	500	219	55	10.5	2,300	6,800	9,100	— 8,600	— 23
Argentina	25,000	600	25,600	303	72	20.2	6,130	25,310	31,440	— 5,840	— 16
Colombia (Res. 500,000)	25,000	800	25,800	32	53	25.0	800	2,600	3,400	+ 22,400	+ 61
Peru	15,000	1,000	16,000	31	58	19.4	600	2,450	3,050	+ 12,950	+ 35
Trinidad	22,000	350	22,350	10	70	9.5	95	4,685	4,780	+ 17,570	+ 48
Other So. & Cent. Amer.	2,500	100	2,600	215	61	14.0	3,000	14,500	17,500	— 14,900	— 41
Total So. & Cent. Amer. (Res. 7,750,000)	330,000	3,850	333,850	844	63	16.5	13,925	64,995	78,920	+254,930	+698
Total Western Hemisph. (Res. 29,300,000)	1,757,500 (D.A.4815)	115,350	1,872,850 (D.A.5131)	33,614	83	16.8	564,605	1,066,530	1,631,135 (D.A.4469)	+241,715	+662
Russia (Res. 5,750,000)	250,000	1,300	251,300	1,060	16	32.2	34,200	172,050	206,250	+ 45,050	+123
United Kingdom	..	..	..	1,672	69	15.4	25,800	33,900	59,700	— 59,700	—164
France	400	..	400	1,000	78	15.3	15,300	20,500	35,800	— 35,400	— 97
Germany†	3,000	..	3,000	327	69	15.6	5,100	23,550	28,650	— 25,650	— 70
Sweden	..	..	..	224	74	14.7	3,300	4,350	7,650	— 7,650	— 21
Spain	..	..	..	182	50	13.7	2,500	3,150	5,650	— 5,650	— 15
Rumania	15,000	500	15,500	25	68	18.0	450	9,800	10,250	+ 5,250	+ 14
Austria	2,600	..	2,600	25	80	16.0	400	2,200	2,600	..	..
Hungary	2,500	..	2,500	33	82	16.0	530	820	1,350	+ 1,150	+ 3
Poland	2,500	100	2,600	44	73	11.4	500	1,800	2,300	+ 300	+ 1
Other Europe	500	..	500	1,000	67	12.5	12,500	25,000	37,500	— 37,000	—101
Total Europe outside Russia (Res. 650,000)	26,000	600	26,600	4,532	70	14.6	66,380	125,070	191,450	—164,850	—452
Total Russia and Europe. (Res. 6,400,000)	276,000 (D.A. 755)	1,900	277,900 (D.A. 761)	5,592	60	17.9	100,580	297,120	397,700 (D.A.1090)	—119,800	—329
Persia (Iran)	85,000	1,000	86,000	13	61	23.0	300	9,800	10,100	+ 75,900	+208
Iraq	30,000	500	30,500	8	50	17.5	140	2,710	2,850	+ 27,650	+ 76
Saudi Arabia	8,000	..	8,000	3	30	26.7	80	275	355	+ 7,645	+ 21
Egypt	9,000	..	9,000	33	82	18.2	600	6,800	7,400	+ 1,600	+ 4
Bahrein Island	8,000	200	8,200	1	60	15.0	15	785	800	+ 7,400	+ 20
Total Middle East (Res. 26,800,000)	140,000	1,700	141,700	58	69	19.5	1,135	20,370	21,505	+120,195	+329
Neth. E. Indies	25,000	300	25,300	75	71	14.7	1,100	12,650	13,750	+ 11,550	+ 32
Sarawak	6,000	..	6,000	1	56	10.0	10	740	750	+ 5,250	+ 14
Sakhalin	2,000	..	2,000	1	60	10.0	10	690	700	+ 1,300	+ 4
British India	1,500	..	1,500	55	18	41.8	2,600	12,590	15,190	— 13,690	— 37
Burma	1,150	..	1,150	20	60	9.5	190	1,360	1,550	— 400	— 1
Japan-Taiwan	1,000	..	1,000	123	29	38.2	4,700	20,400	25,100	— 24,100	— 66
Union of South Africa	..	..	..	346	84	13.2	4,600	7,450	12,050	— 12,050	— 33
Australia	..	..	..	749	69	9.5	7,100	8,700	15,800	— 15,800	— 43
New Zealand	..	..	..	259	81	8.1	2,100	2,800	4,900	— 4,900	— 13
Other Middle & Far East	300	..	300	550	57	11.8	6,500	18,200	24,700	— 24,400	— 67
Total Middle & Far East. (Res. 28,000,000)	176,950 (D.A. 484)	2,000	178,950 (D.A. 490)	2,237	66	13.4	30,045	105,950	135,995 (D.A. 372)	+ 42,955	+118
All other	2,500	100	2,600	157	68	12.7	2,000	4,500	6,500	— 3,900	— 11
World outside U. S. (Res. 43,200,000)	832,950 (D.A.2282)	11,350	844,300 (D.A.2313)	10,500	64	16.0	168,530	523,985	692,515 (D.A.1897)	+151,785	+416
World total (Res. 63,700,000)	2,212,950 (D.A.6062)	119,350	2,332,300 (D.A.6390)	41,600	79	16.7	697,230	1,474,100	2,171,330 (D.A.5949)	+160,970	+441

*Includes aviation gasoline, non-highway motor fuels and all other products of petroleum.
†Production and demand based upon petroleum only. Synthetic products excluded from consideration.
‡U. S. registration estimated, 1946. Other countries, latest available reports, mostly year 1944.

TABLE 2—World crude oil production—1946. Changes from prewar and war periods. (Thousands of barrels)

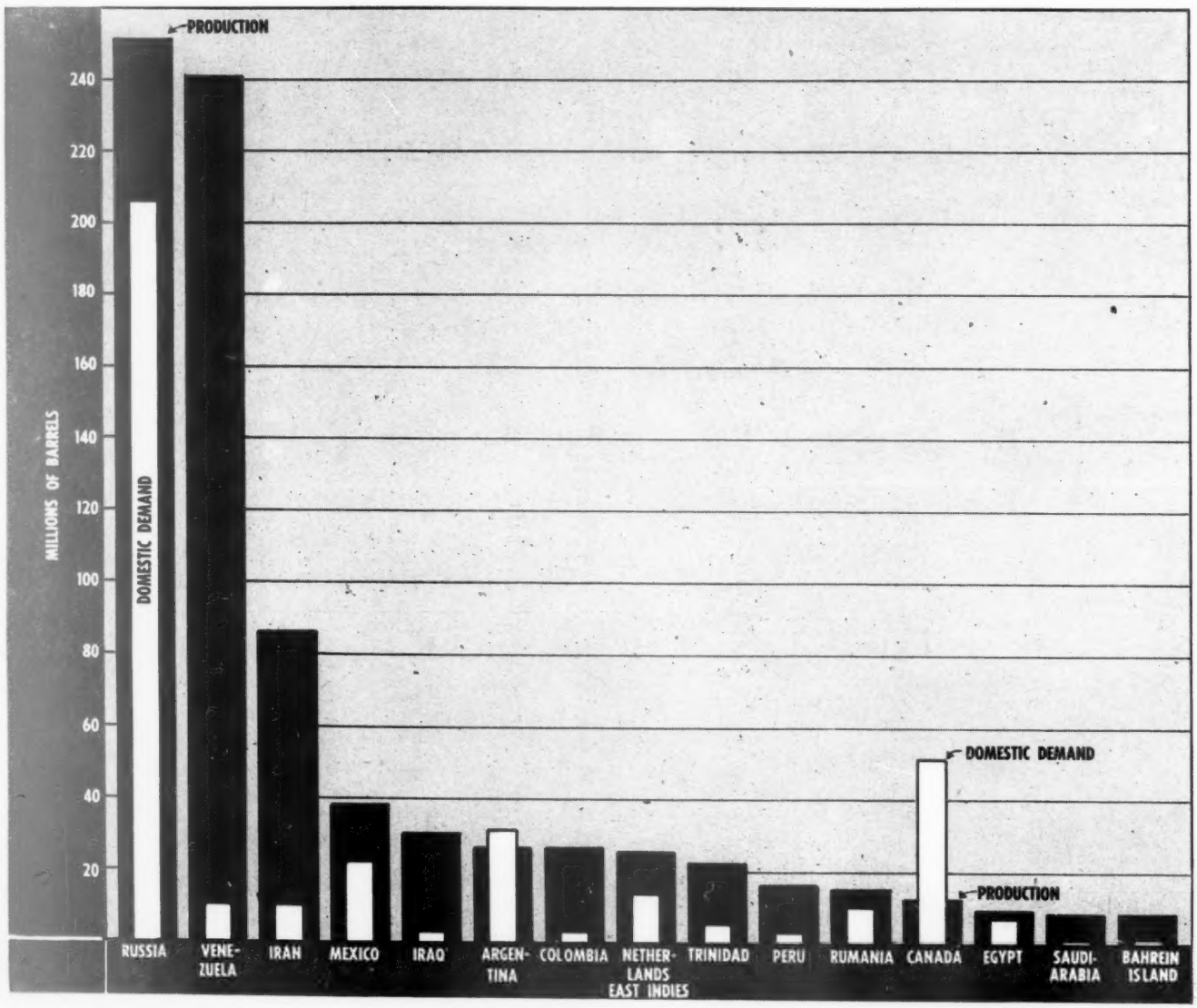
	1940	1944	1946 (projected)	Change 1946 from War period	Change 1946 from Pre-war period
Texas	493,209	748,122	511,000	—237,122	+17,791
California	223,881	311,793	260,000	— 51,793	+36,119
Oklahoma	156,164	124,616	130,000	+ 5,384	—26,164
Kansas	66,139	98,672	100,000	+ 1,328	+33,861
Louisiana	103,584	129,207	130,000	+ 793	+26,416
Arkansas	25,775	29,418	29,000	— 418	+ 3,225
New Mexico	39,129	39,555	35,000	— 4,555	— 4,129
Mississippi	4,400	16,337	20,000	+ 3,663	+15,600
Illinois	147,647	77,413	72,000	— 5,413	—75,647
Balance of U. S.	93,286	102,530	93,000	— 9,530	— 286
Total U. S.	1,353,214	1,677,753	1,380,000	—297,753	+26,786
Venezuela	185,570	267,000	240,000	— 27,000	+54,430
Other South and Central America	81,184	96,500	90,000	— 6,500	+ 8,816
Mexico	44,036	36,120	38,000	+ 1,880	— 6,036
Canada	8,591	9,150	9,500	+ 350	+ 909
Total Western Hemisphere	1,672,595	2,086,523	1,757,500	—329,023	+84,905
Russia	218,600	275,000	250,000	— 25,000	+31,400
Rumania	42,182	20,000	15,000	— 5,000	—27,182
Other Europe	13,078	29,845	11,000	— 18,845	— 2,078
Total Europe	273,860	324,845	276,000	— 48,845	+ 2,140
Persia (Iran)	66,900	102,000	85,000	— 17,000	+18,100
Iraq	24,225	33,000	30,000	— 3,000	+ 5,775
Egypt	6,053	9,125	9,000	— 125	+ 2,947
Saudi Arabia	5,365	6,000	8,000	+ 2,000	+ 2,635
Netherland East Indies	62,011	40,000	25,000	— 15,000	—37,011
Other	30,741	35,900	19,950	— 15,950	—10,791
Total Middle and Far East	195,295	226,025	176,950	— 49,075	—18,345
All other	196	3,563	2,500	— 1,063	+ 2,304
Total outside U. S.	788,732	963,203	832,950	—130,253	+44,218
World total	2,141,946	2,640,956	2,212,950	—428,006	+71,004

States are in the order of 20,500,000,000 bbl.; however, the rest of the world is credited with combined proved reserves of about 43,200,000,000 bbl. Although the United States has 32 per cent of the world's petroleum reserve it produces 62 per cent of the world's petroleum. Recent reappraisal of proved reserves in the Middle East has necessitated an upward revision and the latest estimate prepared by E. DeGolyer credits this area with more than 26 billion barrels. This is six billion barrels more than is credited to the United States. Fig. 3 presents some conception of the ratio of reserves to annual production of the world's principal oil producing areas. The Middle East, with 191.4 times as much reserve as annual production, is by far the greatest future source of the world's oil supply. Here are the figures upon which the chart is based:

FIG. 2

Probable production and domestic requirements of principal petroleum producing countries of the world, year 1946.

Black columns represent petroleum production; white columns, domestic requirements. Surplus or shortage of each country indicated by predominance of black or white columns.



World's Oil Reserves and Production (million bbl.)

	Proved reserves	1946 production	Ratio
United States	20,500	1,380	14.9
Canada	150	9	16.7
Mexico	700	38	18.4
South America	7,750	330	23.5
Russia	5,750	250	23.0
Europe	650	26	25.0
Middle East	26,800	140	191.4
All other	1,400	40	35.0
Total	63,700	2,213	28.9
World outside United States	43,200	833	51.8

Decidedly detrimental to the oil industry, particularly in the United States, has been the fallacious contention that the result of dividing the nation's proved reserves by the annual rate of production represents the number of years of oil supply available. The history of the American oil industry has certainly proved this to be a fallacy; exploratory efforts have seldom if ever failed to prove shortage predictions erroneous. No one has thus far been able to make any definite predictions concerning the length of time our nation or any other nation may have a dependable oil supply. The fact remains that the oil industry has always been able to meet the demand for its products and still manage to maintain a sizeable underground reserve for future needs. We know what our proved oil reserves amount to, but how much additional oil remains underground, yet to be discovered, is a decidedly big question mark. Oil men still have unbounded faith in their ability to find new oil fields in the United States as well as in the rest of the world. If the future may be judged by past performance, there is every reason to believe that the United States has far greater future reserves of oil than are indicated by current reserve to production ratios.

War demands for American oil have been shown to exert an undue strain upon many oil fields, particularly those in the Texas Gulf Coast area and in West Texas. Producing crude oil at greater than maximum efficient rates has proved detrimental to the preservation of reservoir energies and prompted state authorities in cooperation with the industry itself to reduce allowables to a substantial degree when the war emergency ended. As a result, it is believed that United States crude oil production schedules will necessarily have been reduced in 1946 to the extent of 297,753,000 bbl. below the war peak established during 1944. Texas and California will probably assume the greatest share of the cut-back in production, and are likely to show a net decrease in output next year under 1944 of more than 288,000,000 bbl. Table 2 presents estimates of the probable production of the leading oil states, as well as minimum production rates expected in other principal producing areas of the world. In comparison with 1940, the United States is likely to show an increase in output during 1946 over prewar of more than 26,000,000 bbl. The minimum reduction in crude output of the world in 1946 from peak war demand is placed at a little over 428,000,000 bbl. The United States will apparently assume 70 per cent of the world's curtailment program. Even if other countries of the world experience economic production restrictions to the degree indicated, their increase in output over 1940 may be at least 44,000,000 bbl., as compared with an increase in the United States over 1940 of 26,000,000 bbl.

Fig. 4 shows the extent to which the world's crude oil production has increased since 1920. Of particular sig-

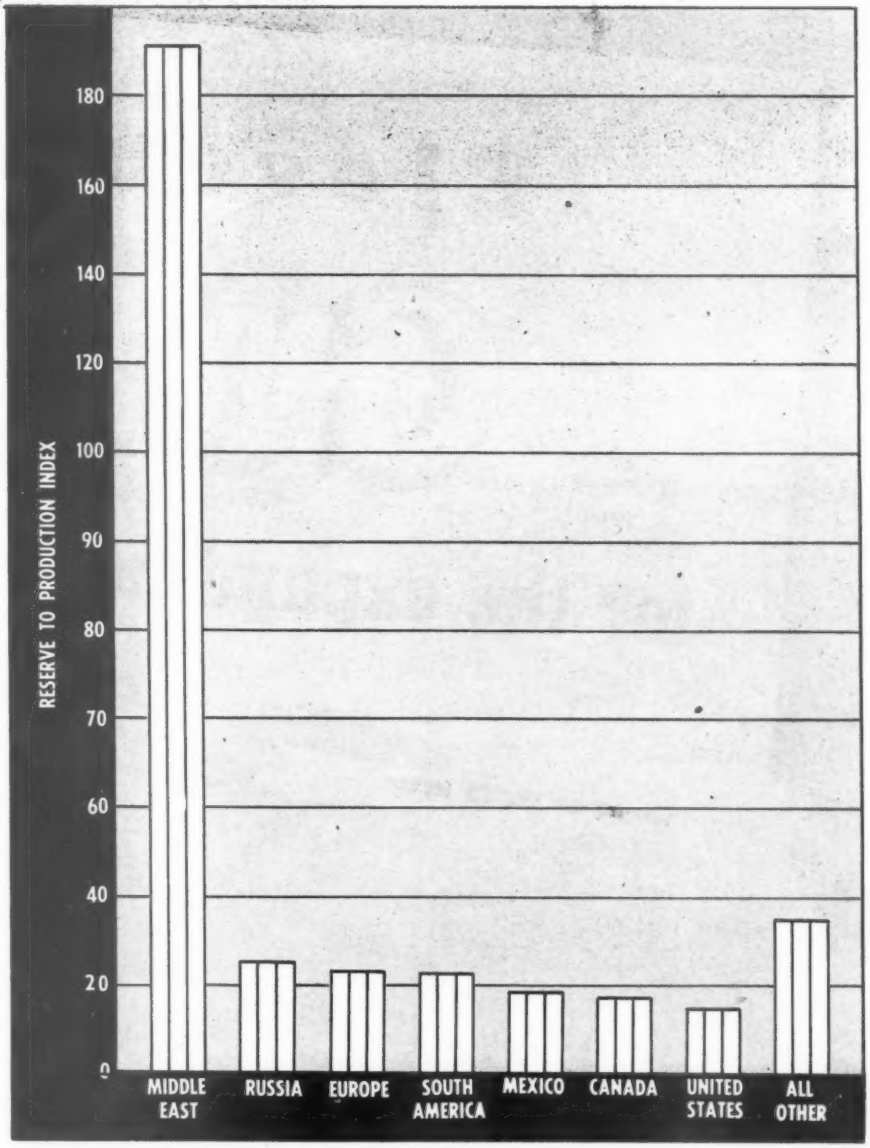


FIG. 3

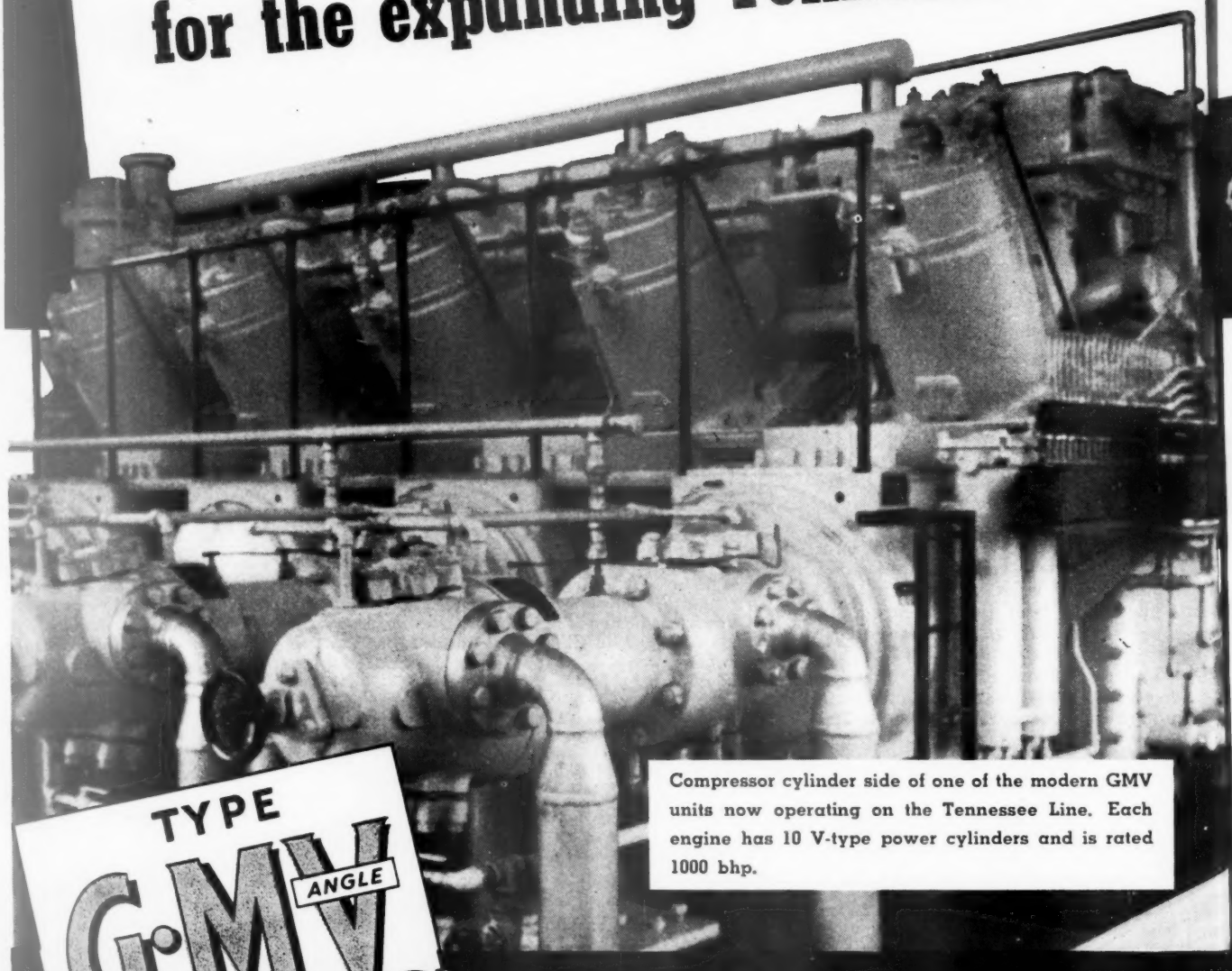
Ratio of crude oil reserves to production in 1946, principal oil producing areas of the world.

These ratios do not imply the number of years of supply represented by proved reserves, but are merely used as an index of reserves as they are related to production. The Middle East shows a ratio of 191; 191 times the annual production. If production of the Middle East is doubled, the ratio would be 95. If United States reserves were doubled, the ratio would be 30 instead of 15.

TABLE 3—World crude production trends.
(Millions of barrels)

	U. S.	Other Western Hemisphere	Europe (including Russia)	Middle East	All other	World total
1920	443	164	39	13	30	689
1925	764	156	76	36	37	1069
1930	898	231	175	49	59	1412
1935	997	252	251	86	68	1654
1940	1353	320	274	109	86	2142
1944	1678	409	325	150	79	2641
1946 (proj.)	1380	377	276	140	40	2213

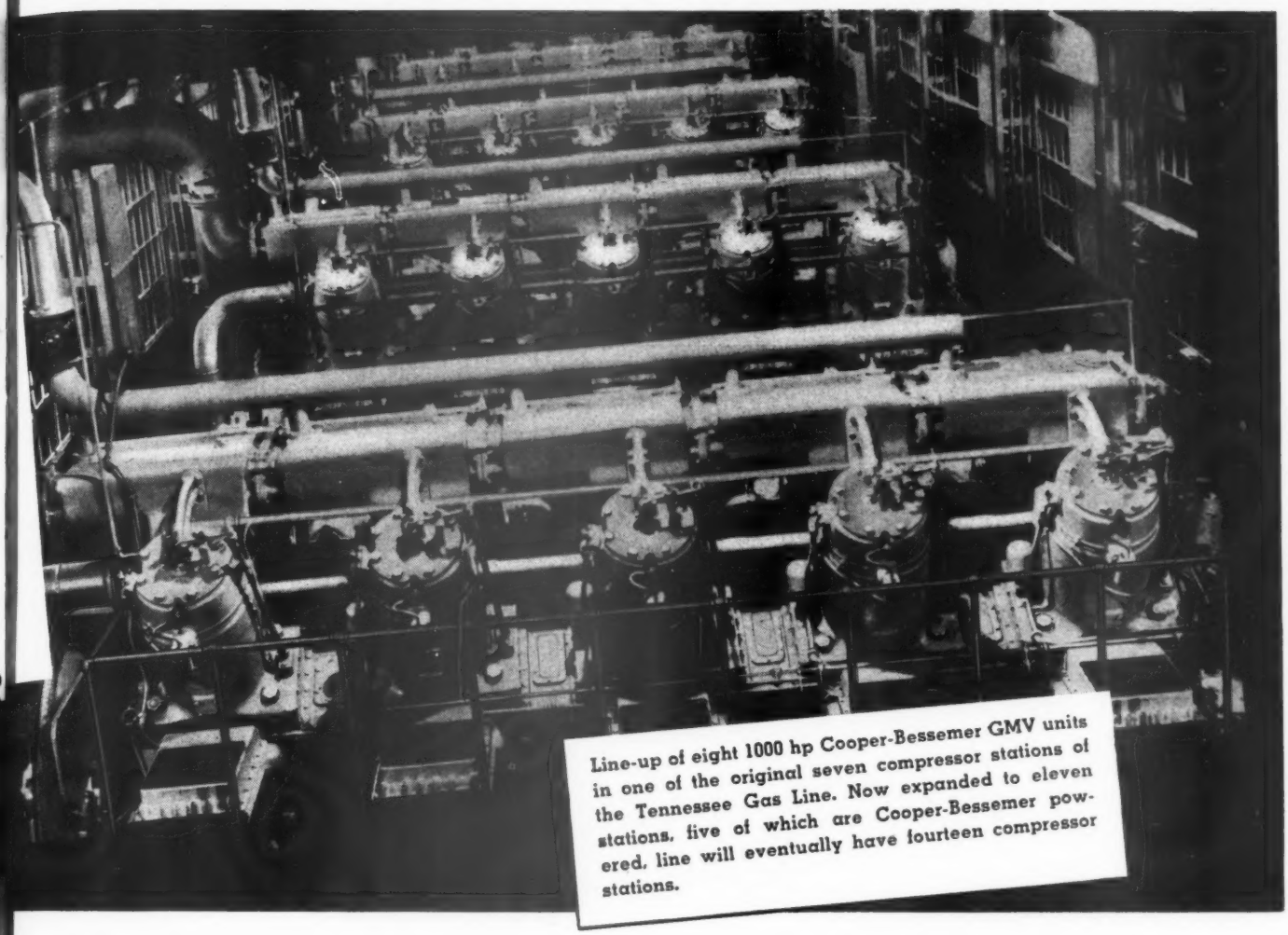
Eleven more GMV's for the expanding Tennessee Line



Compressor cylinder side of one of the modern GMV units now operating on the Tennessee Line. Each engine has 10 V-type power cylinders and is rated 1000 bhp.

TYPE G·MV ANGLE

Compressors



Line-up of eight 1000 hp Cooper-Bessemer GMV units in one of the original seven compressor stations of the Tennessee Gas Line. Now expanded to eleven stations, five of which are Cooper-Bessemer powered, line will eventually have fourteen compressor stations.

Eleven more GMV's will make a total of 42 of these big V-angle Cooper-Bessemer compressors on the Tennessee Gas Line. All are 10-cylinder, 1000 hp units . . . totaling 42,000 horsepower . . . almost half the transmission power on this entire 1,265 mile line.

These new GMV's will help Tennessee Gas & Transmission Company increase their line capacity by some 60 million feet daily. Nine of the GMV's will power a new station, No. 11, at Portland, Tennessee. One will be added to the eight GMV's now operating in Station No. 8 at Batesville, Mississippi; and the remaining unit will increase to eight the GMV's in Station No. 14 at Ashland, Kentucky.

The 31 GMV's originally installed have been in virtually continuous operation from the start, consistently delivering gas in volume well above their performance guarantee.

Modern, versatile GMV's, from 400 to 1000 hp, are particularly well-suited for the most exacting compressor requirements of today and tomorrow. Specify GMV for the latest refinements of compressor design and performance.

by **Cooper-Bessemer**

nificance is the degree to which production has increased in countries outside the United States. The shaded columns, above the United States, have shown appreciable gains since 1930. Russia, South America, and the Middle East loom constantly more important as sources of supply. The figures, expressed in millions of barrels, are contained in Table 3. Between 1920 and 1944, United States production increased 3.8 times. In the rest of the world, crude output is shown to have increased 4.3 times the rate recorded in 1920.

Despite the fact that the United States may reasonably be expected to produce somewhat more oil than will be required for domestic use in 1946, it is evident that considerable quantities of crude oil and refined products will be imported from foreign countries. Although it is difficult to anticipate how much oil will be imported into the United States next year, it is logical to assume that at least as much oil must be imported as may be required for the maintenance of our foreign trade. If our export trade with other nations is maintained somewhere near the level experienced in the pre-war year 1940, the figure may be about 129,000,000 bbl. As the surplus in 1946 is expected to be about 9,000,000 bbl., it follows that the quantity of imports necessary to balance our export trade would amount to about 120,000,000 bbl. If we import that much oil in 1946, provided our exports drop back to the pre-war level, the result will be an increase in imports over 1944 of more than 27,000,000 bbl. Unless our own reserves are augmented by new discoveries—and this appears unlikely at such an early date—it will be necessary for the United States to import substantially greater quantities of crude oil, which would be processed by the U. S. refineries for products needed in export trade with other nations. Table 4 presents the actual supply and demand picture for the United States in 1940 and 1944 and also shows the projections for 1946, which are based upon the foregoing conclusions.

No attempt has been made to determine the petroleum industry's stock position in 1946. The facts show that the oil industry in the United States reduced its combined inventories of crude oil and products between January, 1940, and June, 1945, to the extent of more than 114,000,000 bbl. Obviously, under prospective production levels anticipated for 1946, which will leave but 9,000,000 bbl. in excess of domestic requirements, the industry could not be

TABLE 4—U. S. petroleum supply and demand. Domestic and foreign trade outlook for 1946.
(Thousands of barrels)

	1940	1944	1946 (projected)	Change from war period	Change from pre-war
Production					
Crude oil	1,353,214	1,677,753	1,380,000	—297,753	+ 26,786
Other petroleum liquids	58,867	103,037	108,000	+ 4,963	+ 49,133
Total	1,412,081	1,780,790	1,488,000	—292,790	+ 75,919
Daily average	3,858	4,866	4,077	— 789	+ 219
Imports					
Crude oil	42,662	44,805	85,000	+ 40,195	+ 42,338
Refined products	41,089	47,451	35,000	— 12,451	— 6,089
Total	83,751	92,256	120,000	+ 27,744	+ 36,249
Daily average	229	252	329	+ 77	+ 100
Total new supply	1,495,832	1,873,046	1,608,000	—265,046	+112,168
Daily average	4,087	5,118	4,406	— 712	+ 319
Domestic demand					
All products	1,326,620	1,670,353	1,478,815	—191,538	+152,195
Daily average	3,625	4,564	4,052	— 512	+ 427
Exports					
Crude oil	51,496	34,238	20,000	— 14,238	— 31,496
Refined products	78,970	174,673	109,185	— 65,488	+ 30,215
Total	130,466	208,911	129,185	— 79,726	— 1,281
Daily average	356	571	354	— 217	— 2
Total demand	1,457,086	1,879,264	1,608,000	—271,264	+150,914
Daily average	3,991	5,135	4,406	— 729	+ 415
Stock change	+38,746	— 6,218	..	..	..

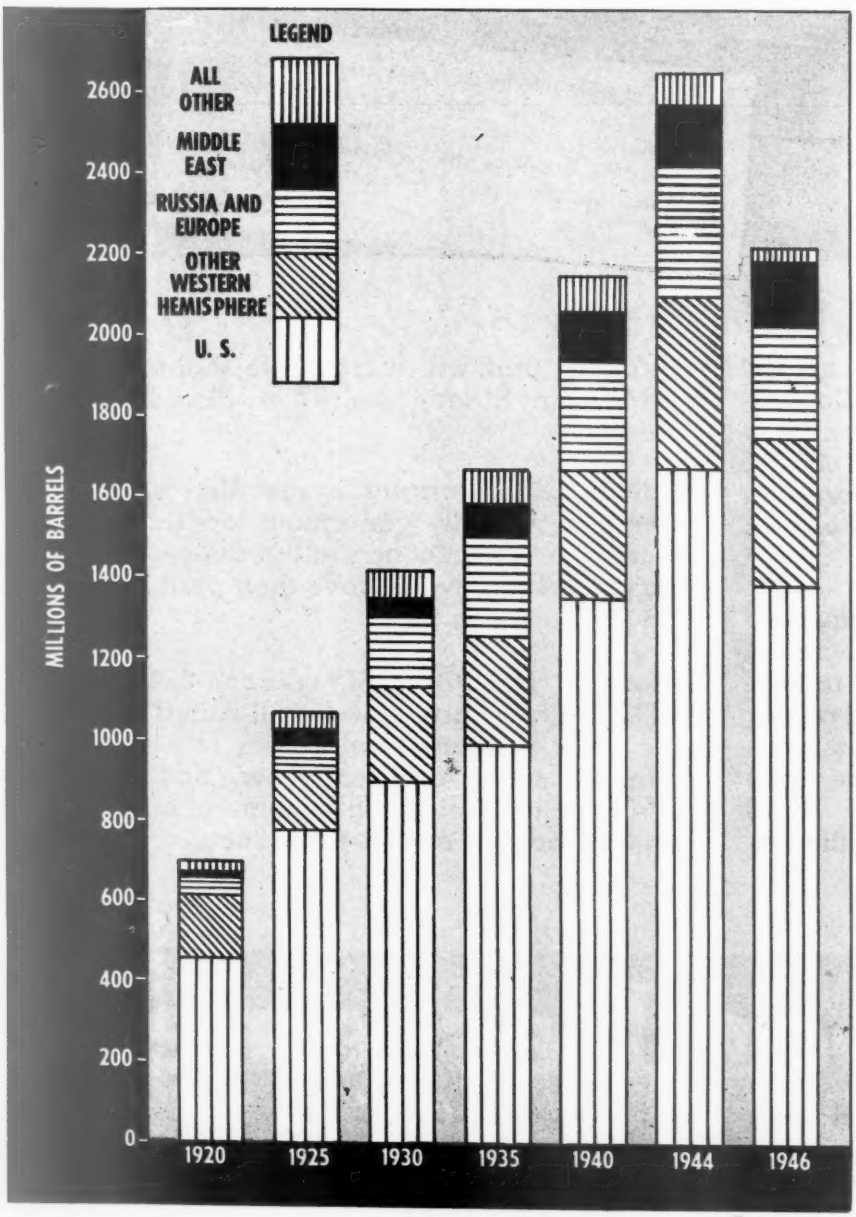
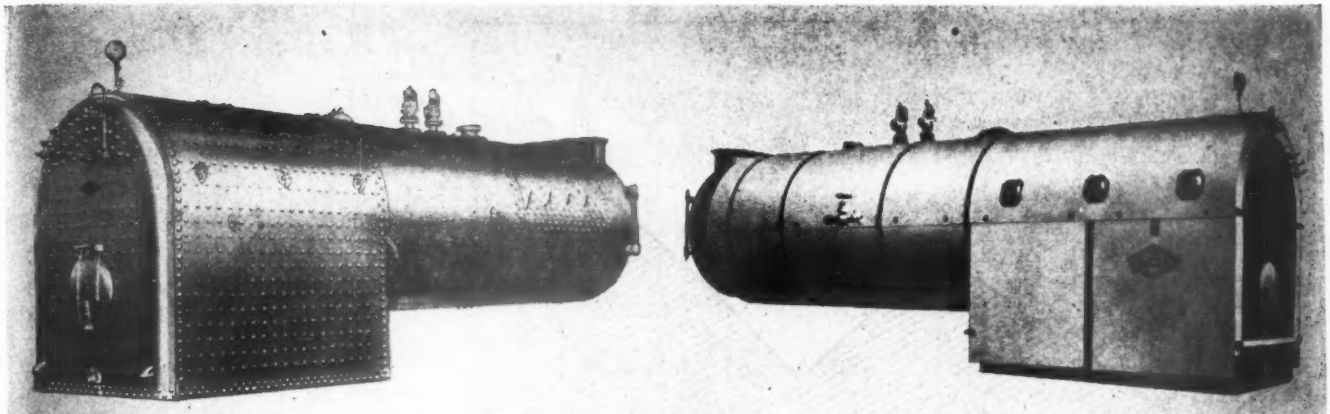


FIG. 4
Trend of world crude oil production since 1920.

Shaded areas above ribbed (U. S.) columns show extent to which production of world outside of the United States has increased. Middle East, South America and Russia show greatest gains. Slump in demand in 1946 will be borne principally by the United States.



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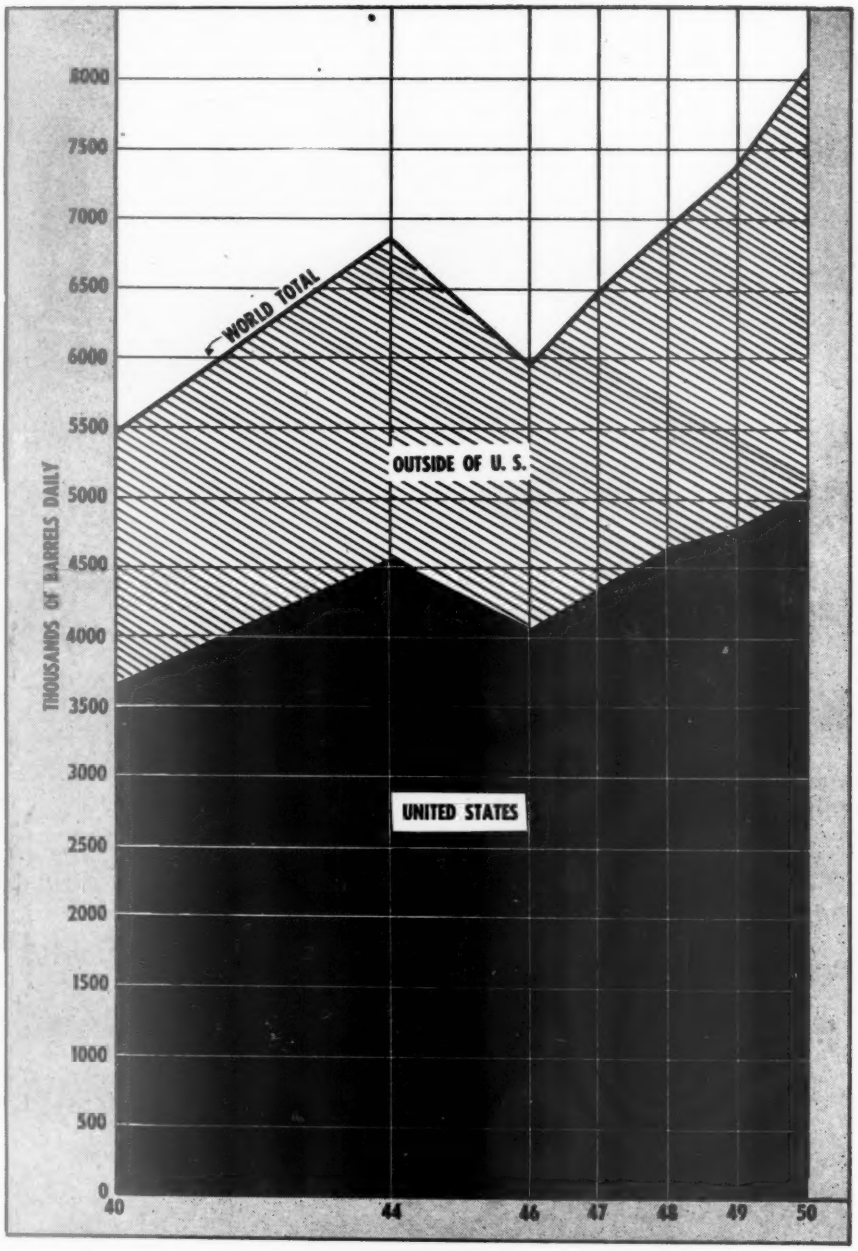

FIG. 5

Indicated demand for petroleum in 1940 and 1944 and prospective world requirements in the post-war years of 1946 through 1950.

Slump in world demand in 1946 is expected to be succeeded by heavy consumptive requirements, which will exceed war peaks by 1948 and continue an upward trend well beyond 1950.

expected to build up its stock position to any appreciable degree.

Although stocks were reduced to minimum working levels by the end of the war, the prospect of substantially reduced demand in 1946, under war levels, will act to lengthen the number of days of supply represented by the industry's inventories. In 1940, the industry's combined stocks of all oils was 563,277,000 bbl. and the total daily demand was 3,981,000 bbl. Stocks at that time were 141 times the daily demand. In July, 1945, stocks of all oils totaled 453,159,000 bbl. and the daily demand in the first 7 months of the year was 5,550,000 bbl. Current stocks are about 82 times the average daily demand for this period. If stocks are maintained at about current levels during 1946, the reduced demand may in effect lengthen the supply by at least 20 per cent above the war level. Obviously, any stock build-up in 1946, above present levels, would have to be supplemented by additional imports.

If the domestic and foreign demand for United States petroleum and its products in 1946 amounts to 1,608,000,000 bbl., as is indicated by these figures, the deficit in supply, after providing for the production of 1,488,000,000 bbl., must be supplied by imports to the tune of about 329,000 bbl. daily. This is based upon the assumption that the U. S. will continue its export business at about the rate prescribed in 1940. Although this appears to be a high rate of imports, it does not displace any of our own normal production of crude oil.

Any projection of future supply and demand for petroleum in the United States must not fail to consider our nation's enormous proved reserves of natural gas. Augmenting our proved and prospective reserves of crude oil, natural gas reserves are presently estimated at minimum to be in the order of about 150 trillion cu. ft. A recent report prepared by E. DeGolyer placed the nation's natural gas reserves as high as 200 trillion cu. ft.

Potentially, our proved crude oil reserves represent a future gasoline supply of about 9,000,000,000 bbl. If recent scientific developments in the conversion of natural gas to motor fuel are applied commercially over the next 5 to 10 years, as they undoubtedly will be, it is likely that processing plants for converting natural gas to motor fuel may become one of the nation's major sources of motor fuel production. Such plants may eventually convert about one-third of the nation's natural gas production into motor fuel, and still enable the petroleum industry to provide sufficient supplies of gas for domestic and industrial fuel requirements.

Astounding developments contributed by the Fischer-Tropsch process of converting natural gas into motor fuel indicate the possibility of producing one barrel of gasoline from 10,000 cu. ft. of natural gas. Thus, if we utilize in the future one-third of the nation's natural gas reserves for the manufacture of motor fuel (using the minimum reserve figure of 150 trillion cu. ft.) the nation's potential supply of gasoline may reasonably be increased to the extent of another 5,000,000,000 bbl. This spells a total potential supply of gasoline, without considering future discoveries, of at least 14,000,000,000 bbl. In other words, our crude oil potential gasoline supply would be multiplied by 1.55. This is highly significant in the light of a definitely foreseeable growth in future demand for petroleum products throughout the world, and it may have a decid-

TABLE 5—Probable course of world petroleum demand.

(Thousands of barrels)

Year	U. S. demand	Daily average	Per cent of world demand	Index	Foreign demand	Daily average	Per cent of world demand	Index	Total world demand	Daily average
1940	1,326,620	3635	66	100	678,380	1859	34	100	2,005,000	5494
1944	1,670,353	4576	67	126	829,674	2273	33	122	2,500,027	6849
1946	1,478,815	4052	68	111	692,515	1897	32	102	2,171,330	5949
1947	1,585,000	4342	67	119	788,500	2155	33	116	2,373,500	6497
1948	1,685,000	4616	67	127	836,500	2292	33	123	2,521,500	6908
1949	1,750,000	4795	65	132	936,600	2566	35	138	2,686,600	7361
1950	1,850,000	5070	63	139	1,095,000	3000	37	161	2,945,000	8070

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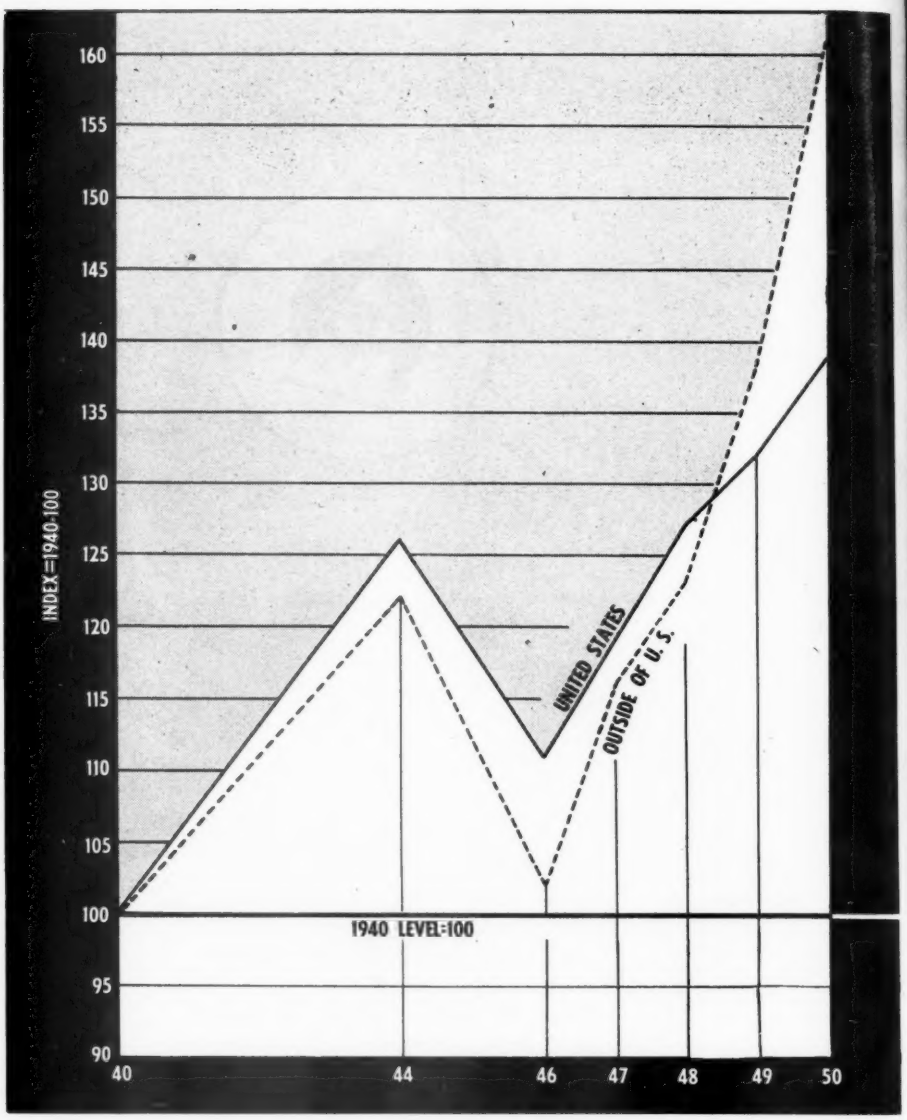
FIG. 6

Probable course of petroleum demand for the United States and the rest of the world, through the year 1950.

This index is based upon the U. S. pre-war year 1940, which equals 100. U. S. demand is expected to drop 11 per cent under 1944 in first post-war year and rise to 39 per cent above 1940 by 1950. The rest of the world may show an increase in demand by 1950 of 61 per cent over 1940.



edly important bearing upon future needs for crude oil in the United States.

A look into the future, following the expected slump in 1946, reveals a decidedly favorable demand outlook. Fig. 5 presents some conception of the probable demand for petroleum in the postwar period through the year 1950. The years 1947 through 1950 are expected to show substantial increases in demand, which are likely to aggregate a 46 per cent increase for the world by 1950, compared with 1940. The United States will probably experience an increase in demand over this period of about 39 per cent, whereas the rest of the world is likely to show a gain of 61 per cent. This substantial gain in demand of foreign nations is predicated upon the fact that many nations disrupted by war experienced severe declines in domestic consumption of petroleum products. Thus, by comparison with the outlook for the United States, postwar requirements of foreign nations will necessarily rise to a relatively greater degree by reason of subnormal requirements during the war years. (See Fig. 6.)

A look ahead presents a somewhat startling conviction with respect to the huge supplies of oil necessary to meet the growing postwar requirements of the world. Table 5 presents a projection of the world demand for petroleum through 1950. The United States produced in excess of 5,000,000 bbl. of petroleum daily in the first half of this year, a figure that was considered to be substantially above the nation's maximum efficient rate. Yet, the demand outlook will be above 5,000,000 bbl. daily by 1950, and calls for a corresponding rate of production. This makes it apparent that the search for new sources of oil supply in the United States must continue with increasing vigor. If new reserves are not made available in the intervening years, thus permitting maximum efficient production rates to conform with such requirements, it is obvious that the United States must become an importer of foreign oil to a much greater degree than is immediately evident.

The rest of the world will experience no difficulty in meeting all their domestic requirements from sources outside the United States. This is evident by the quantities of proved reserves outside the United States and the extent to which production of such foreign sources may be increased. Although it is somewhat startling to find that the probable demand for petroleum in 1950 will exceed 8,000,000 bbl. daily throughout the world, it is also comforting to realize that the world faces no possible shortage of that precious commodity for a great many years to come. ★ ★ ★

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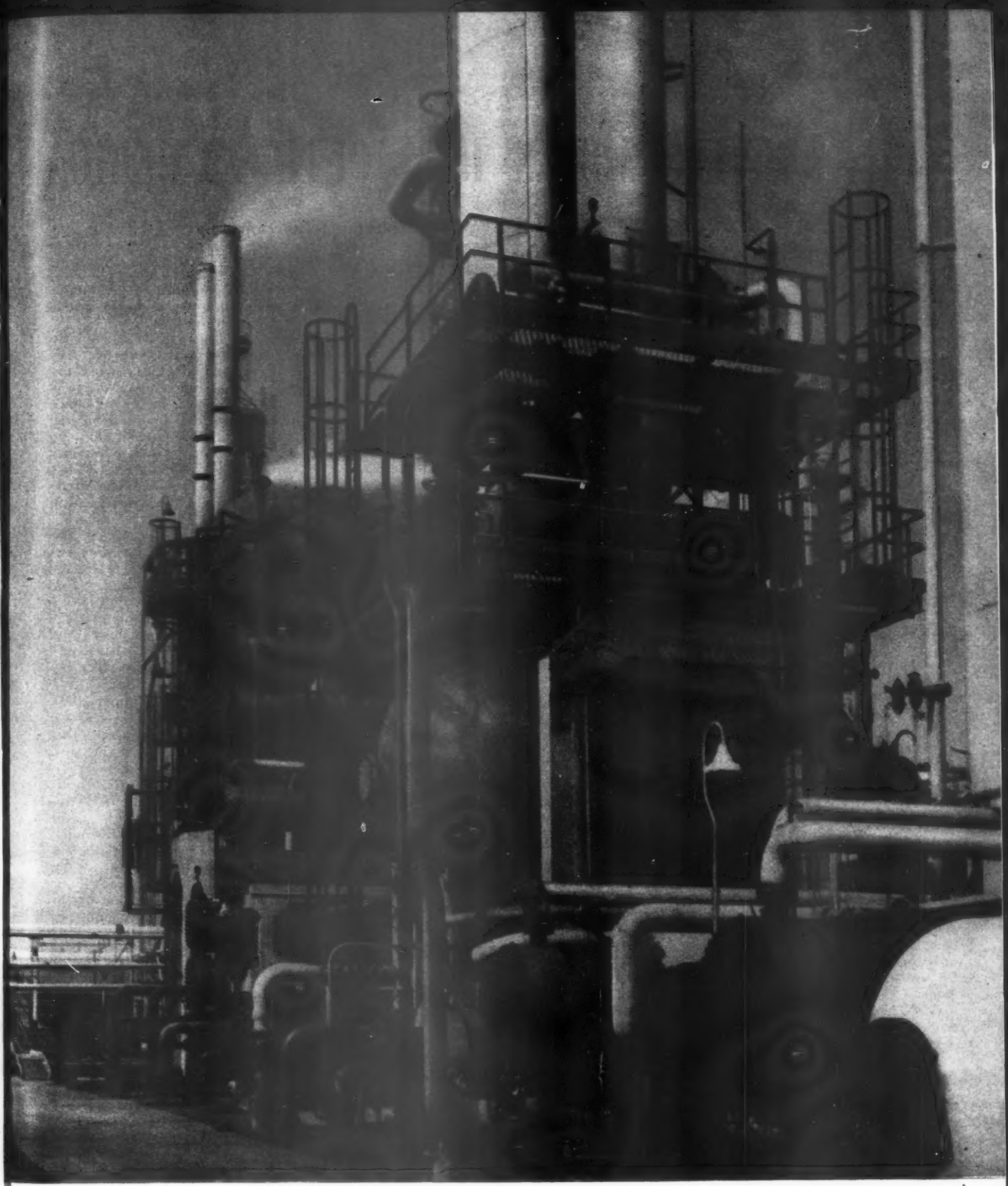
SINCLAIR GETS EXCLUSIVE OIL RIGHTS IN ETHIOPIA

Sinclair Oil Corporation has signed a 50-year lease with Emperor Haile Selassie of Ethiopia for the exclusive oil rights to his 350,000 sq. miles of kingdom. In return for the privilege of exploring and shipping oil from the country, Sinclair has agreed to pay royalty to the emperor and to build one or more schools, hospitals, clinics, and research foundations. It will also pay for educating Ethiopians in the United States.

Once before, in 1935, the emperor had assigned to the Anglo-American oil interests the sole rights of exploring the country, but the deal fell through after creating a world-wide furor. The new grant was signed in New York for Ethiopia by Ato Aklilou Abte Wold, vice minister of foreign affairs and chief delegate to the San Francisco conference for Ethiopia.

Under the concession, all oil development rights for the entire territory, equal in size to Texas, Oklahoma, Massachusetts and Rhode Island, will rest with Sinclair. After the first 5 years 50 per cent of the territory will be released. Then, after another 5 years, 25 per cent more of it will be released. The Ethiopian government is entitled to royalty payments on a stipulated basis for the first 5 years and thereafter at an increased rate subject to revision in 15 years from the beginning of production.

H. F. Sinclair, president of Sinclair Oil Corporation, said: "Development of petroleum in commercial quantities would greatly strengthen the United States economically in the Near East, and would contribute to the economic and social welfare of Ethiopia." ★ ★ ★



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OIL DEVELOPMENTS IN SOUTH AMERICA

By **J. E. BRANTLY,** President, Drilling and Exploration Company, Inc.

EXCLUSIVE

SINCE the first oil well was completed at Titusville in 1859, the annual production curve of the nation, with few exceptions, has been continually upward. The producing capacity of all the wells in the country has been a reasonably parallel curve to that of the actual production, though with greater variations. The problem now before the industry is how much longer the upward trend of these two curves can continue and when the consumption or demand curve will cross the production curve, if indeed it has not already done so.

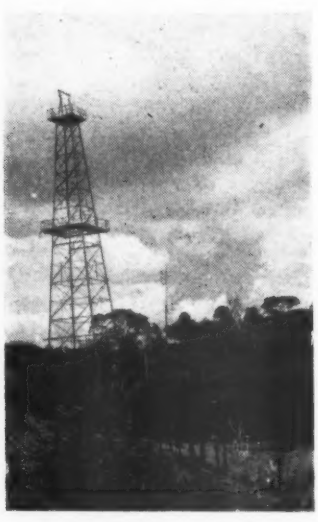
Until the discovery and partial development of the East Texas field there had practically always been a reasonable balance between the capacity of the nation to produce petroleum and the capacity of the nation to consume its products. This balance was maintained more or less automatically by the laws of supply and demand. Contemporaneously with the development of the East Texas field and continuing uninterruptedly since the technique of finding, developing and producing oil has been enormously improved, there had been brought into production more oil than could be currently consumed, until the beginning of the war.

During this same period the industry has come to realize that its former practice of taking from a well all that it could produce was wrong and resulted in a lesser per well or per acre recovery than under producing methods that preserve the reservoir energy in that degree compatible with sound business economy. Even though this radical improvement in producing methods was forced by overproduction, nevertheless, the theories and practices are none the less logical and have been developed against a background of sound engineering and science.

Immediately preceding the war we were consuming approximately that amount of oil that should have been produced under sound and conservative operating practices. With the beginning of the war the increase in demand exceeded the increase in producing capacity resulting from new discoveries. In consequence the industry was forced to increase the production of many fields beyond that permitted by former sound practices, in order that the requirements of the nation at war might be supplied. Now, for some few weeks after V-J Day, there has been only a minor reduction in the demands on the industry and the nation doubtless is still producing a substantial quantity in excess of that which it could under proper producing practices. Now the question is: Will the requirements be reduced to that quantity dictated by sound methods of production?

For the past few years new discoveries have not kept pace with the quantities of oil withdrawn from the reserves, despite an intensive campaign of exploration. Taking into consideration the restoration of normal peace-time activities, a normal increase in consumption over 1940, and the continued considerable demand by the armed forces, coupled with the relatively little new oil that is being found, there appears to be no reason to expect that our normal producing capactiy will soon exceed or even equal the nation's demands on the industry. On the contrary, if we are optimistic or expect even reasonable industrial and cultural development in the nation, it is difficult to see how our normal producing capacity wil ever again equal the national demand for petroleum products. There is always the possibility that some new discovery, or series of discoveries, will upset such a condition, but we have not had them in 15 years, or since the East Texas field, and it appears unlikely that we will have them in the future. I do not mean to imply that our capacity to produce is necessarily going to begin to recede soon, but rather that such increase as we may have will be at a lesser rate than the increase in demand.

If and when America can no longer fulfill its own requirements, it must then seek its deficit in foreign fields. We supplied the world with oil for many years and it is now our turn to be supplied with such requirements as we cannot produce ourselves.



Well in Venezuela

Outside continental North America great regions in South America, Asia, Asia Minor, and the East Indies have enormous discovered reserves and probably much greater fields as yet undiscovered. Europe, too, doubtless has rich deposits as yet unfound. Of these regions the greatest in known reserves, and probably in potential reserves as well, are South America and Asia Minor: Venezuela and Colombia and Iran, Iraq, and Arabia.

South America is the continent that interests us most because of its proximity to us and because its nations are our friends and economic complements. They need the products of our labor, which we must sell, and we need the products of their soil and subsoil, which we must buy. In order that we may sell we must buy and in order that they may buy they must sell.

Mexico

Oil was first produced commercially in Mexico, which we shall include with South America, though actually it is a part of North America, in the early 1900's. The first discoveries were in the series of fields later known as the "Golden Lane", which lie between the Panuco and Tuxpam rivers a few miles inland from the Gulf and in the Panuco field on the north side of the river of the same name. Other oil has been found south of the Tuxpam River and on the Gulf side of the Isthmus of Tehauntepec in the states of Vera Cruz and Tobasco. Production in Panuco is in fractured limestone of Comanchean age and in the "Golden Lane" or Lower Fields the oil is found in cavernous limestone of a different facies of the same age. In the Isthmus country the production is generally associated with salt domes. The first locations were made on the basis of great seepages and several of the discovery and many of the later wells actually produced as much as 100,000 bbl. of oil daily from the limestones.

Compared to the amount of exploration work that has been done and the number of wildcat wells that have been drilled in the various oil producing regions of this country, Mexico, with the exception of the immediate fields, is virtually untouched. The entire Gulf Coast region of Mexico, with the exception of a minor area in Vera Cruz where the mountains reach down to the sea, is potential oil bearing territory. It is not reasonable to suppose that the Rio Grande is uncrossed by the oil producing zones of Southwest Texas, nor may

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we assume that all the oil of the Tampico-Tuxpam region has been found in the Panuco and Lower Fields. The country south of the city of Vera Cruz and into Campeche doubtless has possibilities much greater than the few small fields that have been found in the Isthmus country.

The coastal strip of Mexico in its sedimentary facies has its counterpart in the Caribbean coast of Central America and Panama. The Pacific area in some of these countries also has possibilities.

Colombia

Colombia has production in the valley of the Magdalena and on the extensive plains that border and extend a hundred miles or more inland from the sea. A considerable strip of Tertiary sediments that border on the Pacific are possibly oil bearing.

Venezuela

Venezuela is the great oil producing country of South America and second largest in the world. There are two producing regions in this country: The Maracaibo Basin, occupying the northwestern corner of the Republic and lying north of the primary lineament of the Andes and between two lesser ranges, and the Orinoco Basin lying south of the Andes and north of the Orinoco and extending into the headwaters of the great river.

In the Maracaibo Basin, where great seepages led to the original discoveries, oil is produced from or found in the Pliocene (possibly) Miocene, Oligocene, and Eocene of the Tertiary and more recently in the La Luna and Cachiri (Cogollo) limestones, which are comparable in age, Comanchean, to the producing limestones in the Panuco and in the Lower Fields of Mexico. These limestone discoveries in the Maracaibo Basin are recent, though Comanchean oil has been expected and drilled for many years. Though the Maracaibo Basin produces enormous quantities of oil and has extensive proved reserves, there is yet much exploration drilling to be done, both for Tertian oil and for Cretaceous oil.

The Orinoco Basin is the northeastern extremity of that great geosyncline, which lies between the Andes Mountain system on the north and west and the great Brazilian Land Shield on the south and east. It begins with the southern part of the Island of Trinidad and extends westward and southward to Tierra del Fuego passing successively through Venezuela, eastern Colombia, and the eastern parts of Ecuador, Peru, and Bolivia and on into Argentina. Extreme western Brazil and western Paraguay are likewise in this geosyncline. This feature is some 6000 miles long, with a width ranging from 150 to 400 miles. There are seepages from one end of it to the other, and in fact there are producing fields at both ends and in the middle.

In eastern Venezuela the oil was first found near the eastern shore across the Gulf of Paria from the island of Trinidad and has been moving progressively westward to a point to the southward of Caracas, some 300 miles from the easternmost field. The first discovery was based on surface geology and seepages and the subsequent discovery wells were located principally by geophysical methods. The production occurs along faults and stratigraphic traps, as well as on folds. Insofar as known the same or similar geologic conditions continue westward to the Colombian border and into that country. It seems probable that the oil fields will follow the geology.

Trinidad

Trinidad, which is the extreme northeastern end of the great geosyncline, has been producing oil from many fields for many years. The production thus far developed is Tertiary in age though there are doubtless Cretaceous possibilities. This statement likewise holds true for eastern Venezuela and eastern Colombia.

Ecuador

Ecuador has small production from the Tertiary sediments along the Pacific Coast and there are doubtless further possibilities for commercial oil. On the eastern side of the Andes in the great geosyncline there are seepages and without question good possibilities for production.

Peru

Peru has been a producer of oil from the extensive Talara field since the early 1900's. The oil comes from Tertiary formations comparable to those of Ecuador to the northward and to Pacific Coast Colombia still farther north where no wells have as yet been drilled. In eastern Peru there are many areas of seepages and production has been found in the great Aguas Calientes anticline. The production is derived from grits and conglomerates that lie between marine upper Cretaceous and deep sea dark blue limestone that may be lower Mesozoic or upper Paleozoic (Permian). This structure is some 16 miles long and 6 miles wide with a reversal of upward of 2000 ft. The sand thickness is about 400 ft., though the upper 150 ft. only carries oil. This structure gives an idea of the type feature that may be found in the great geosyncline.

Peru, likewise, has a little production on the shore of Lake Titicaca at an elevation of 12,000 ft. above sea level. The producing horizons here are probably Mesozoic. Similar possibilities exist across the line to the southward in Bolivia.

Bolivia

A substantial part of eastern Bolivia lies in the great geosyncline. In the western part there are many anticlines in the steeply folded Paleozoics. Small production has been found in the Devonian on several of these features and many others have prospects equally as good. To the eastward of the foothills are broad flat plains under which oil bearing formations and structures reasonably may be expected. The Amazon Basin country of eastern Bolivia is likewise a region of possibility.

Paraguay

The Chaco region of Paraguay, which lies to the west of the river of the same name, occupies its part of the great geosyncline. The surface of the Chaco is table flat. The possibilities of production depend upon the pressure of oil-bearing Mesozoic and Paleozoic formations involved in favorable structual features. Expectation of the presence of such conditions is entirely reasonable. Tertiary beds may be present though there is no evidence of them, at least in marine facies.

Argentina

The greater part of Argentina lies within the limits of the great geosyncline and in consequence has possibilities for production. Oil fields extend from the Bolivian border to the Comodoro Rivadavia field, which is a few hundred miles north of the southern tip of the Continent. The potentialities of Argentina might be expected to be much greater than those indiciated by its present production.

Chile

Chile is a very long very narrow country extending along the Pacific Ocean for 3000 miles. It has possibilities of oil in the extreme southern end of the country where the great geosyncline ends. The country here is cold, desolate and dreary, but drilling is under way and if there is oil eventually it will be found and produced.

Uruguay

Uruguay does not appear to have encouraging possibilities for production.

Brazil

Brazil has an area of three and one quarter million square miles, which is considerably larger than continental United States. Probably a million square miles of this vast region is occupied by sedimentary beds that have possibilities of production to varying degrees. Doubtless the best prospective area is the coastal strip through the states of Bahia, Sergipe, and Alagoas. This is true because commercial oil has been found there and is now being produced. One considerable oil field with wells varying in size up to 500 bbl. daily has been found. Three small oil fields, together with two gas fields, likewise have been brought into production. The Parana Basin of southern Brazil with oil shales and fossil oil sands is a region of possibility. The Territory of Acre in extreme western Brazil lies in the great geosyncline within sight of the Aguas Calientes field in eastern Peru. It definitely has possibilities of oil. The Maranhao Basin in northeastern Brazil is a region of nearly a half million square miles of Mesozoic and Paleozoic strata. For this reason, and though little else is known of the basin, it cannot be discarded as being without possibilities. The Paleozoic basin along the Amazon River has several thousand feet of sediments in which gas has been found in shallow wells.

The Guianas

The Guianas, with a narrow coastal strip, do not appear to have interesting possibilities for oil.

Summary

Thus all the countries of Continental Latin America and likewise Cuba are

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either producing oil or have interesting possibilities of production with the exception of Uruguay and the Guianas. Venezuela, Colombia, and Peru, and also Ecuador to a modest extent, are exporters of oil. Mexico and Argentina produce substantial quanties though insufficient for their normal needs. Brazil and Cuba produce small quantities, and the Island of Barlados likewise produces a little oil and some gas. In none of these countries have the possibilities of new fields been exhausted. On the contrary, compared to the oil producing regions of the United States, relatively little prospecting has been done.

The countries that have petroleum resources in abundance need to produce them for the other nations of the world and to use the proceeds to purchase products of the "have not" nations. Those having modest resources need to produce the oil for their own benefit in order that they may use for other purposes such monies as they would otherwise be forced to spend for petroleum products. Petroleum fuels and lubricants compose one of the greatest items of expense and one of the most important cultural commodities used by the peoples of any civilized and progressive nation and there is no nation among these that can afford to purchase from foreign sources all this commodity that it could and should use, and this includes our own nation. We simply could not afford to buy five million barrels of oil daily from foreign sources.

As this country needs oil we must turn toward the nations to the south of us. Americans are peculiarly fitted for the oil industry and practically all the oil fields of the world have been discovered and developed by them. This is true because our experience in the industry goes back nearly a hundred years whereas the peoples of other nations have just begun.

These countries need our experience and they need our venture capital to develop their oil and we need to sell the supplies and the labor and skill that such operations would require. We need some of their oil to amplify our domestic supply and they need to fulfill their own requirements from their own oil to expand and develop their industry and culture. Our requirements are complementary.

The petroleum and indeed mining laws of our neighbors should be so written that they retain for the nation a fair share of their resources or the income from such resources and at the same time grant to foreign interests an adequate opportunity for fair return on its capital placed in hazardous ventures. The operator working in a foreign country must realize that the resources are the property of the nationals of that country and must be developed with that point in mind. ★ ★ ★

P 122.

VENEZUELA AND COLOMBIA OIL DEVELOPMENT

THE Richmond Exploration Company, a subsidiary of Standard Oil Company of California, in November, 1944, acquired oil concessions from the Government of Venezuela covering approximately 1,772,000 acres of land lying to the west of Lake Maracaibo. Of this particular area, some 350,000 acres were under water on the Maracaibo lake bed and the rest was relatively high and dry. About 6 weeks later another group of concessions amounting to about 1,075,000 acres, most of it lying in the delta of the Orinoco River in the easterly part of the State of Monagas and in the Territory of Delta Amacuro, Eastern Venezuela, was issued to Richmond, thus giving the company an interest in concessions of 4448 square miles of Venezuelan territory. (The concessions on these lands permitted exploration, drilling, and exploitation under the Venezuelan petroleum law of 1943.)

Many difficulties lay in the way of speedy development of these newly acquired interests. In wartime, the acquisition of men and materials was a problem of major magnitude, and even when they might be available there was still the prime difficulty of transportation. Nevertheless, the Richmond Exploration Company made plans to begin exploratory drilling at the earliest possible moment. Geologists and geophysicists were sent to the various fields and surveys were begun almost immediately following completion of the agreements.

The Lake Maracaibo region in Western Venezuela is one of the most prolific producing areas in the world but to date the bulk of its production has come from the east side of the lake and off the east shore. The Maracaibo area concessions granted to Richmond Exploration Company were on the west side of the lake. To the north some operators, notably Shell Oil Company, has met with a fair degree of success in older fields and has recently completed 4 deep wells for a total production of about 20,000 bbl. a day.

Richmond's first venture in Venezuela was a joint one with the Colonial Beacon (S.O.N.J. affiliate) and Sun Oil Companies, a wildcat in the La Montanita block, District of Miranda, State of Falcon. At the moment of writing this well is drilling at a depth of 5440 ft.

At the time the Monagas and Delta Amacuro concessions were signed it was realized that exploration and development in this area would be especially difficult. The Orinoco delta is situated in a tropical area, much of the territory is inundated, and geophysical work will be done with the aid of shallow draft boats.

From the initiation of these Venezuelan activities, Richmond Exploration Company has been moving along as fast as circumstances would permit. Operation in swamp lands requires extra equipment, which is very difficult to get, and progress is further delayed by the character of the terrain and its inaccessibility. Now that war restrictions are being lifted and transportation is becoming easier, the entire process will no doubt be considerably expedited. No basic enlargement of the original program is planned, however, and actually no change is likely until enough wells have been completed to indicate what the prospects of production are and what the development process should be. This is distinctly a wildcat venture in which actual discovery is the ultimate and only determining factor in the extent of future expansion.

At the present time four drilling strings are on the way and these will comfortably take care of all immediately projected drilling operations. Barring some exceptional and unforeseen development, Richmond Exploration Company is not likely to institute any large scale drilling venture in Venezuela until such a move is justified by the results of the more conservative program now being carried on. Drilling in the swampy Orinoco region is likely to be costly and Richmond is certain to subject it to a most careful test before launching a major effort. Indeed, transportation difficulties, territorial isolation, and local conditions in wildcat areas far removed from the source of equipment and manpower supply, are sufficient to elevate costs under any system of operation, and hence excite operators into the most cautious approach.

Richmond Petroleum Company of Colombia's operations in Colombia are scattered and diverse. They include both privately owned properties and government concessions. The company is reported to have given up its El Doce concession after the failure of two test holes, and on its Chorrea Manteca lease near the town of La Dorado has so far drilled two dry holes, Nos. 1 and No. 2 Chorrea Manteca. These were abandoned at 1260 and 3289 ft., respectively. Equipment is now being moved in for Chorrea Manteca No. 4, located at Latitude 5° 38′ north, Longitude 0° 38′ west (Bogota). The company is now rigging up for a wildcat in the Caraballo tract. This well is located at Latitude 10° 28′ north, Longitude 0° 16′ west (Bogota).

The outlook so far as Colombia operations are concerned is much the same as in Venezuela. War restrictions made it very difficult to carry on wildcatting with any degree of dispatch. The problem of procuring equipment and experienced workers slowed progress generally. With the lifting of restrictions there no doubt will be some quickening of activity but in the end future expansion will be limited by the success or failure of the present exploratory operations. ★ ★ ★

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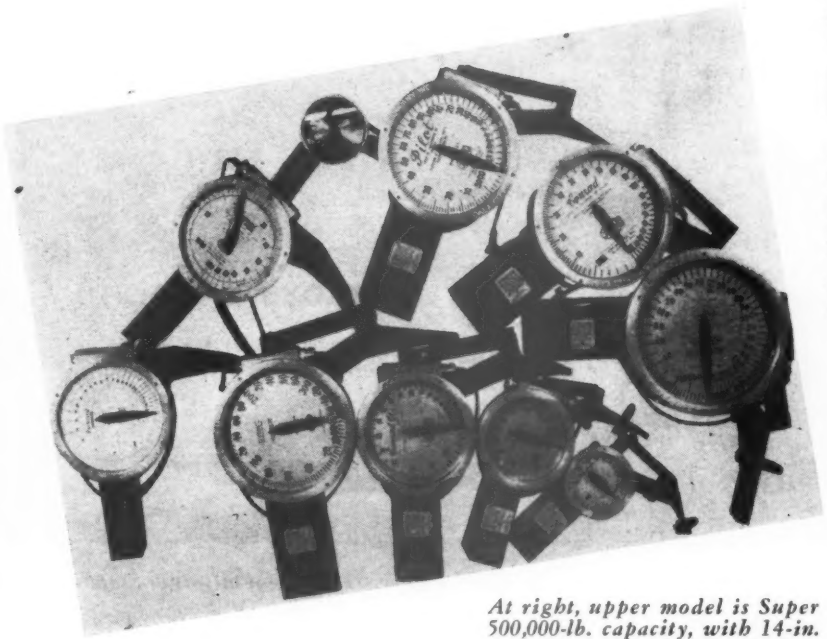

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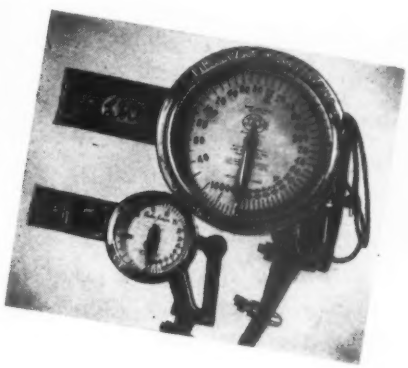

At right, upper model is Super 500,000-lb. capacity, with 14-in. dial. Lower model is Packer Special, capacity 40,000 lbs. with 6-in. dial.

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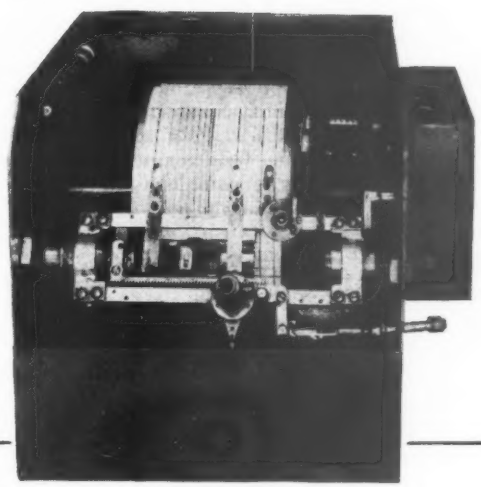

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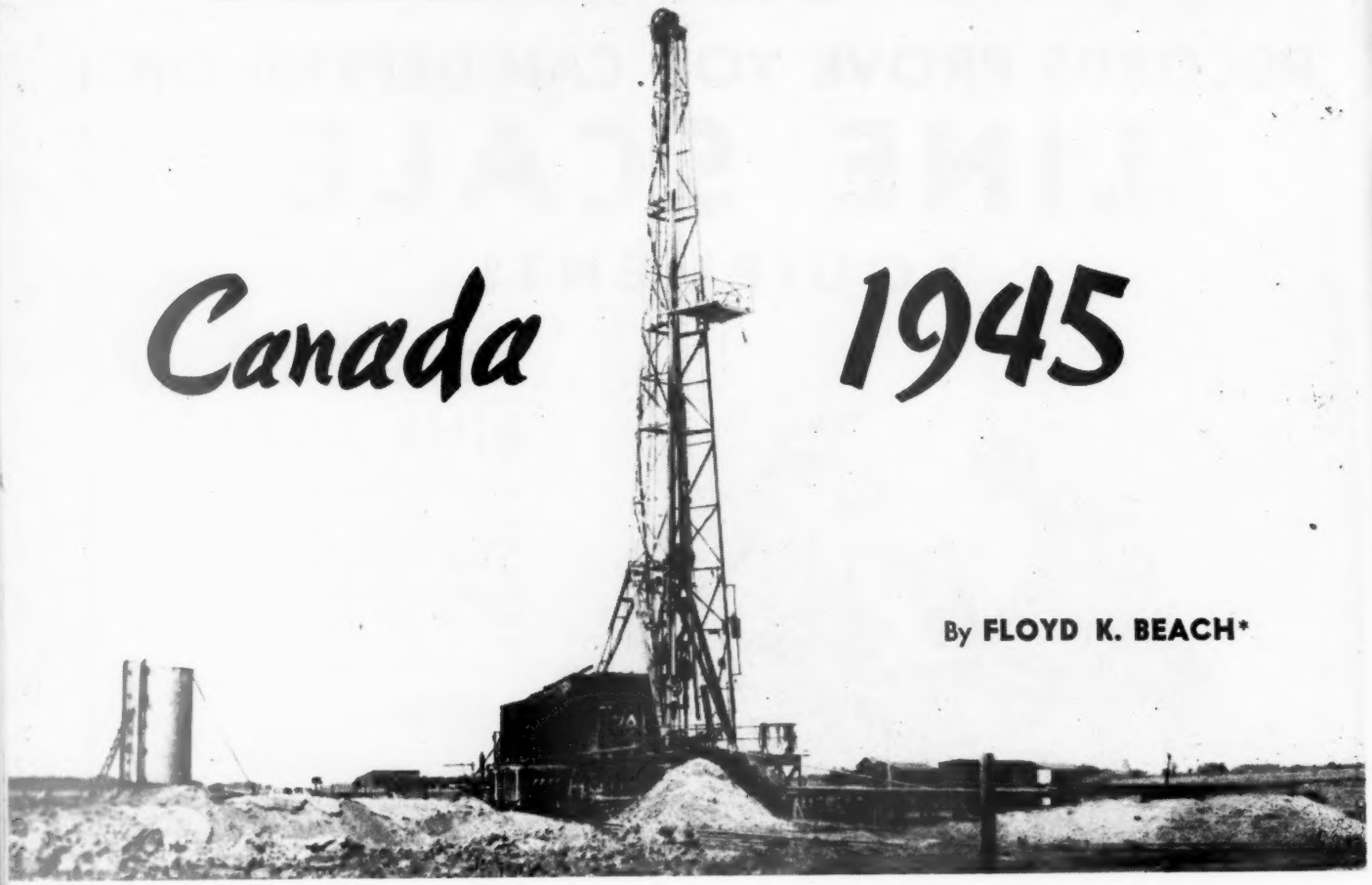

By **FLOYD K. BEACH***

Approaching completion Taber Province 87-15-A.—*California Standard photo.*

The end of World War II finds Canada still actively searching for new oil fields. If oil production from the Northwest Territories is disregarded, most of which was destined for Alaska, Canada's production was only about one-sixth of her consumption, the rest being imported. Alberta produced 98 per cent of the 1944 total and Turner Valley most of that. (See Table 1). The 2 per cent not produced in Alberta came from stripper wells in New Brunswick and Ontario, and many Ontario wells have been in production since 1881, some since 1866.

EXCLUSIVE

The statement that five-sixths of Canadian consumption is imported suggests that production could be increased materially without economic danger, but it should be noted that both in 1938 (the last prewar year) and in 1944, 60 per cent of Canadian consumption was east of Fort William, at the head of Great Lakes navigation, and served by pipe line to Sarnia from Mid-Continent fields and by tankers to Montreal and eastern ports. Also, 15 per cent of Canadian consumption was tributary to the Pacific Coast, served normally by ocean tankers. The remaining 25 per cent of consumption, on the prairies, is the logical market for Alberta oil, for eastern Canada and the Pacific Coast can be supplied more economically from the United States (or other sources on tidewater), at least until United States production is in a much more precarious position than at present.

There has been no publication of statistics showing consumption by the armed forces during the war, but it is known that the Alaska highway and related developments consumed large amounts of gasoline. It is also known that the Empire Air Training program was particularly active in the prairie provinces and consumed considerable aviation gasoline and that the quality of motor gasoline was lowered to permit manufacture of a maximum quantity of aviation spirit. Two alkylation plants were constructed to make 100-octane gasoline and stabilization of isobutane was greatly stepped up to supply the alkylation plants. The air training program began to taper off for some months before V-E Day and came to an end early in September.

During the last year several important discoveries have been made, and production from other Alberta fields has increased materially but not as yet in great enough quantity to offset the decline in Turner Valley. A number of companies have revenues from United States and Canadian operations consequently are active in search for oil, and some privately financed operations are also drilling.

Drilling Activity

Alberta made record footage in 1944 of nearly 600,000 ft. of hole of which 326,000 ft. was oil field development and 11,400 ft. gas field development. A part of this was subsidized drilling sponsored by Wartime Oils, which company was supported by Dominion Government funds. Nineteen Turner Valley completions in 1944 were sponsored by Wartime Oils compared with a total of 22 wells completed in the same field by other interests. With cessation of subsidized drilling, 1945 footage has declined sharply.

Footage figures for other parts of Canada are not available in full. In Saskatchewan, Imperial Oil continues wildcatting and a separate paragraph will cover work by this major company and its affiliates. Bata Petroleums are actively developing a gas field near Unity, and there has been some other scattered wildcatting and field development extending east from Alberta oil discovery near Lloydminster.

In Ontario, drilling has been limited to small natural gas development.

In Quebec, Continental Petroleums continues drilling in Gaspe Peninsula with two rigs.

In Nova Scotia, Lion Oil Refining

*Floyd K. Beach, engineer for the Petroleum and Natural Gas Conservation Board, Calgary, has covered Canada in *The Petroleum Engineer's* Foreign Number for several years.

Baash-Ross News

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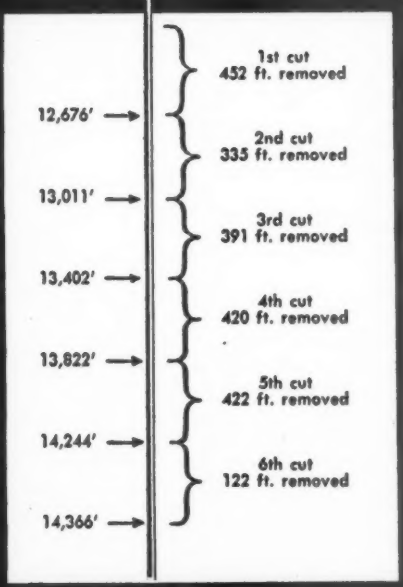
All below 2 1/4 miles deep!



In one of the deepest cutting jobs ever made a Baash-Ross External Cutter started at 12,676 feet and in 6 uniform cuts completed the job at 14,366 feet. Note in chart the long length of the cut sections—and all approximately the same footage. Dependable recovery plus maximum pipe salvage . . . a *double Baash-Ross advantage!*

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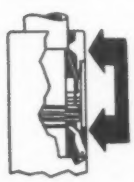
BAASH-ROSS EXTERNAL PIPE CUTTERS

THINK OVER all the performance features you might want in a pipe cutter and you'll find that—because of the critical nature of cutting jobs—no feature is more important than *consistent* dependability. When you run a cutting tool in the hole you want to be sure it's going to work—not once or twice—*but run-after-run until the job is finished.*

The Baash-Ross job cited here is typical of the unusual dependability engineered into Baash-Ross cutting tools . . . typical of Baash-Ross runs being duplicated almost every day in wells throughout major oil producing territories of the world. It is different only in the extreme depth at which the cuts were made—proving that, *regardless of the depth*, here is an outside cutter you can *consistently* bank on to do the job right!

THESE UNIQUE DESIGN FEATURES

embodied in Baash-Ross External Cutters are what insure greater dependability and maximum cutting efficiency. . .



• **Spring-Cushioned** cutting action is provided by this large spring through which *all* cutting pull is applied. It smooths out rough jarring vibration of the run-in string . . . protects the knives . . . assures smoother cuts.

• **Exact Spacing** of each cut a short distance below the tool joint is another vital feature. This automatically safeguards against cutting at the thick-walled, hardened tool joints.

• **No Overshot** is needed because the Baash-Ross Cutter automatically supports the cut-off section for withdrawal from the hole. You cut and recover in *one* trip . . . with *one* tool!

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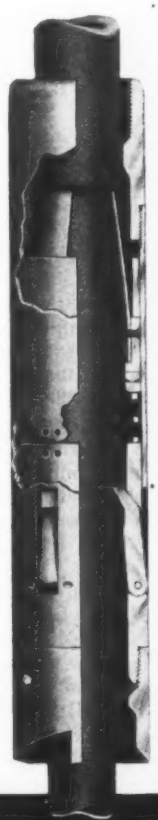


There's a Baash-Ross External Cutter for every size and type of outside cutting job—whether tubing, drill pipe or casing. Get the full details from your nearby Baash-Ross representative—or write direct. Pages 288-289 of your Composite Catalog also contain helpful data.

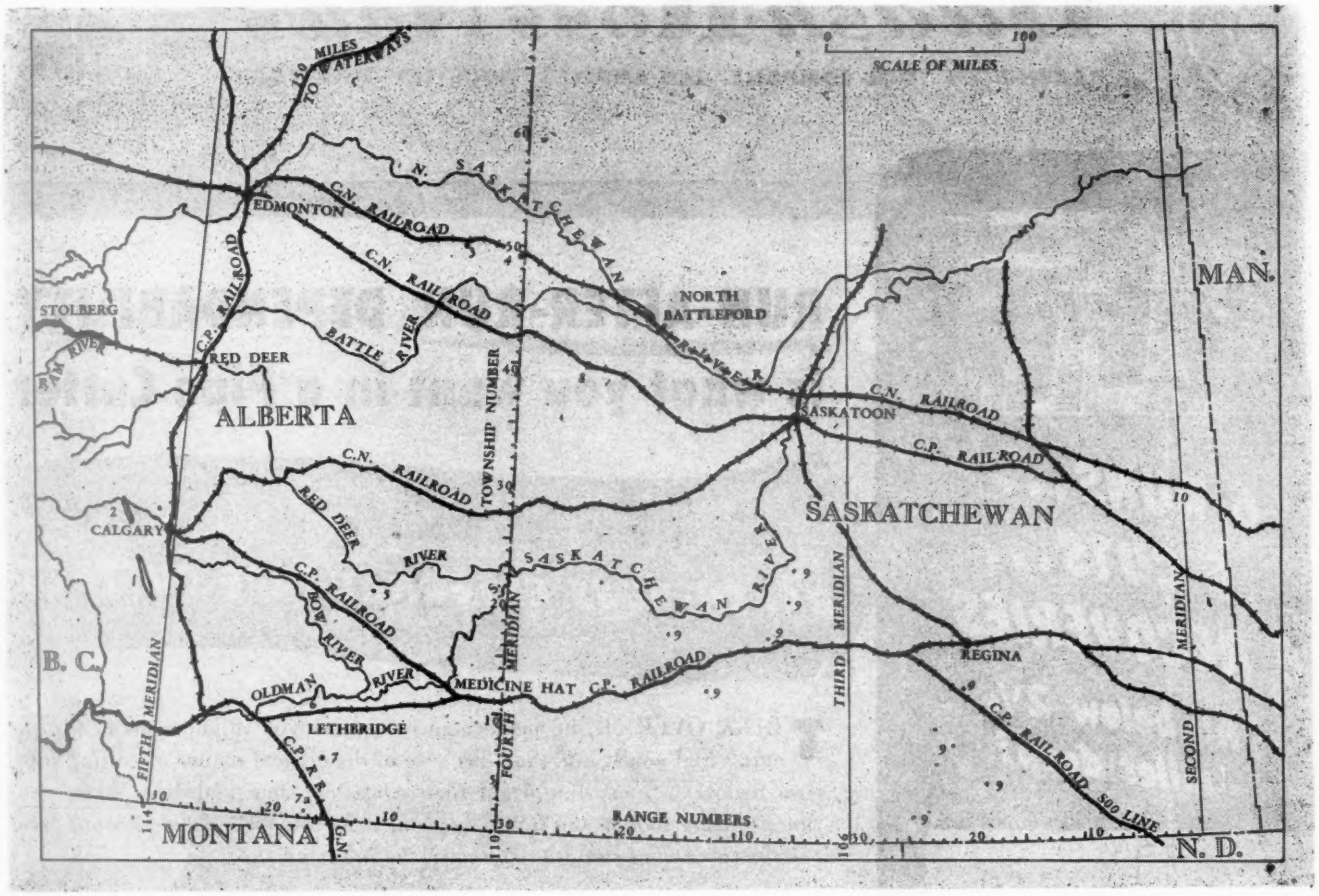


FIG. 1. MAP OF PART OF ALBERTA AND SASKATCHEWAN with location of recent oil and gas development. 1. Turner Valley. 2. Jumpingpound. 3. Vermilion. 4. Lloydminster. 5. Princess. 6. Taber. 7. Conrad. 7a. Hay Lake. 8. Unity. 9. Wildcats in Southern Saskatchewan drilled by Imperial and Norcanols. 10. Kamsack.

Company abandoned a test in Cape Breton Island, south of Mabou inlet, at 5579 ft. Sun Oil Company of Philadelphia began a test of the Minudie Anticline. The location is about 5 miles south of Amherst, and east of Chignecto Bay, most northerly part of Bay of Fundy. The objective is the Horton series, of Mississippian age, which has been producing oil in New Brunswick. Imperial drilled this structure some years ago but stopped somewhere around 4000 ft. in an evaporite series. Sun geologists expect the Horton series will be as deep as 10,000 ft., but are prepared to go deeper if necessary.

In Prince Edward Island, a well drilling from piers in Hillsborough Bay has just been abandoned at a record depth for Canada, 14,696 ft. The test was drilled by Socony-Vacuum and Cities Service through Island Development Company. It also had the Horton series as its objective. It is believed to have bottomed in the Mississippian but in the last few thousand feet the beds were of salt and gypsum that created drilling difficulties.

In Northwest Territories, the Canol project was closed down and drilling has ceased.

Oil Discoveries

Jumpingpound. Shell Oil Company of Canada made fast time in drilling its 4-24-J, reaching a depth of 9947 ft. in 6 months drilling time, using natural gas internal-combustion engines and completing about the middle of last December as a gas and condensate well. That well was followed by 10-14-J, about ½ mile to the southwest, where it is hoped that completion will be below the gas cap, and drilling is proceeding below 9200 ft. The company has outlined an area in which the owners of subsurface rights may pool their royalties through unitization. The area to be unitized comprises nearly 19,000 acres and extends in a strip varying from 1¾ to 2½ miles in width trending northwest for about 15 miles. The unitization contract calls for continuous drilling after completion of 10-14-J and if oil is discovered in commercial quantity the company is committed to a development and exploration program expanding as oil discoveries are made up to a maximum of one rig for each 2000 acres of proved oil area and with a minimum ultimate development of one well to 80 acres of oil land. The contract is naturally more complex than is outlined above, but it does call for orderly and economic development, and so long as the unitized area is found to include all the productive oil in the pool, the development will be undisturbed by offset requirements, which so frequently lead to uneconomic drilling.

The outline of the unitized area, with the knowledge gained by drilling, has been delineated entirely by seismograph. Credit for working out a technique applicable to use of the seismic survey in the disturbed belt goes jointly to Heiland Exploration and Shell's seismic department, and the Shell organization deserves much praise for finding oil in the maze of disturbed beds where many others have failed. The Department of Lands and Mines, the predominant owners of subsurface rights, must be thanked for taking a leading part in promoting orderly development.

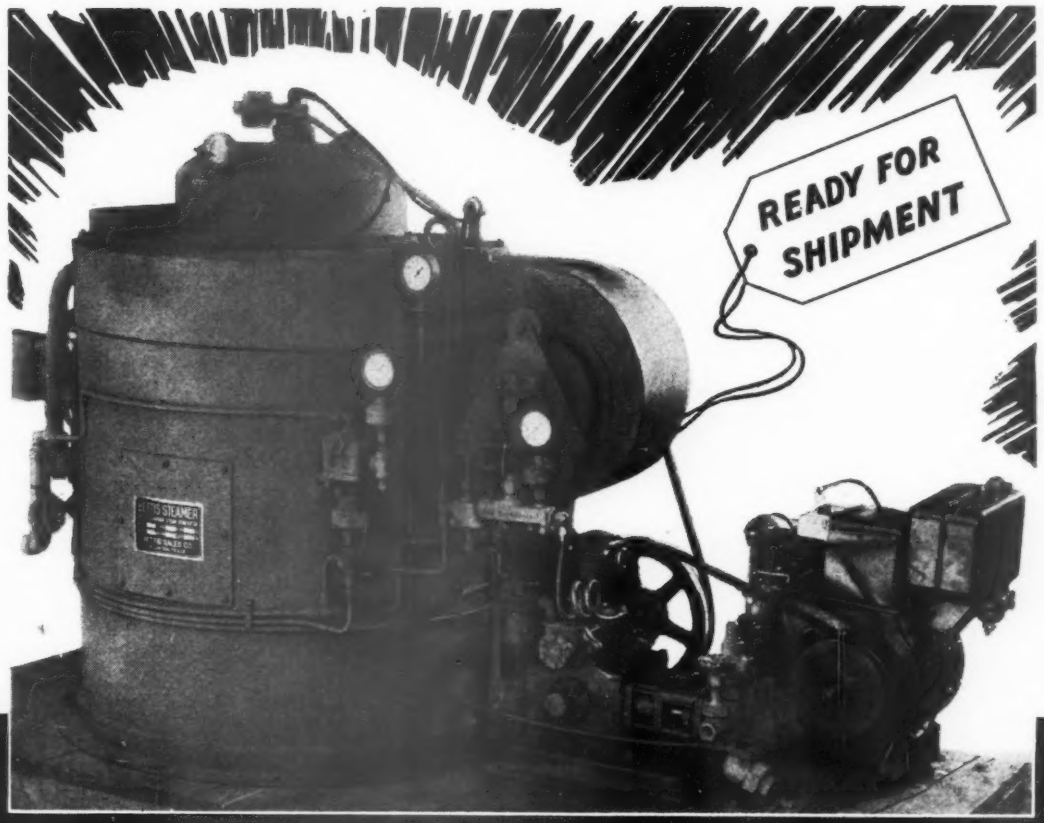
Hay Lake. In September a well some 6 miles northwest of the old Red Coulee-Border field and 12 miles NNE of the Cutbank field in Montana, reported oil in the top of the Madison limestone. Testing is under way as this goes to press. Privately financed companies, Admiral and British Dominion, financed the well. They and McColl Frontenac (affiliate of the Texas Company) hold the adjoining leases. The location followed a seismic survey.

Princess

Discovery of oil in the Jefferson lime was reported a year ago[1]. The first offset well south was a failure, but 3 wells at ¼ mile intervals eastward have been successful and 2 more are drilling with prospect of enlarging the proved area materially. One of these seems to mark a gas cap.

A wildcat about 6 miles south of the Jefferson lime discovery found oil in the

[1]F. K. Beach, *The Petroleum Engineer*, October, 1944, page 114.



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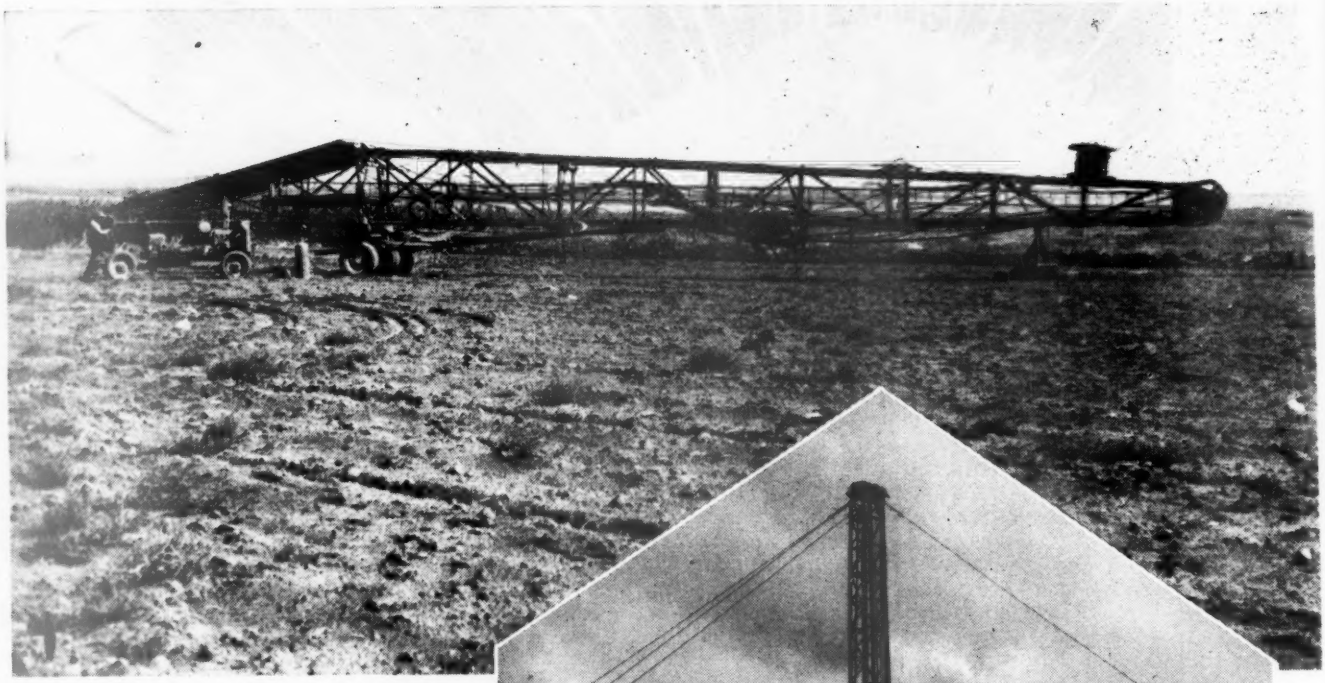
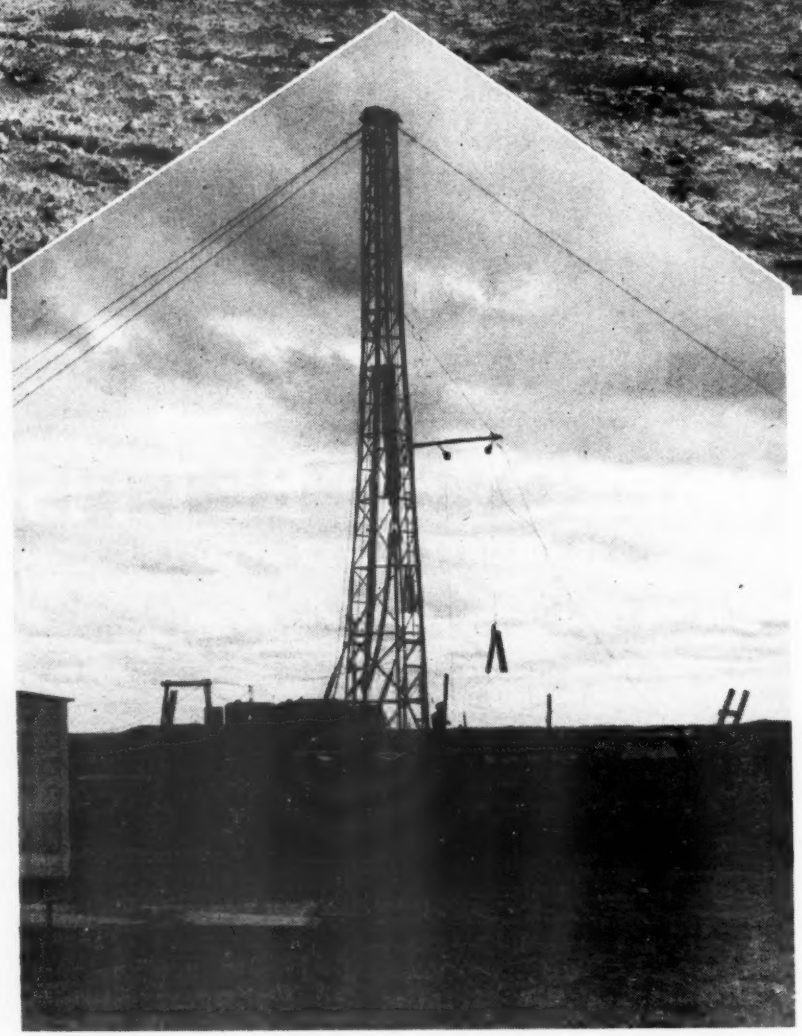


Type of rig used in drilling many wells on the plains. Moving to location for Taber Province 67-15-A.
—California Standard photo.



***Right—Portable rig used in* drilling Bata wells.**
—Bata Petroleum photo.

top of the Madison, apparently in commercial quantity. Its southerly offset explored to the Jefferson without success, but completed in the Madison as a gas well.

Another wildcat some 3 miles west of the latter 2 has found gas in the Sunburst sand and is exploring deeper zones.

Conrad

California Standard found oil in its Conrad Province 2, as reported last year[2] and has since extended the field to include 16 producers. Production comes from the Ellis sand of Jurassic age at a depth of about 3000 ft. The sand wedges out against buried Madison ridges, so there have been some failures, and in tabulating footage it has been considered that any well located farther from a producer than the adjoining legal subdivision (40 acres) is a wildcat. Under this definition 3 of the wells that found oil were started as wildcats and completed as extension discoveries.

The discovery of this field is credited to exploration by test holes. The company has drilled a large number of holes over quite an area in the southern part of Alberta, carrying each hole to a marker that can be definitely identified for subsurface mapping.

A pipe line from the field to Conrad railway station is being laid to facilitate handling the crude, as road transportation becomes expensive in wet weather. The pipe line will be only 4 or 5 miles long. Present outlet for the oil is by rail to Imperial Oil at Regina. Gravity of the crude is 25-26 deg. API.

Lloydminster

Discovery of a small oil producer in 1939, about 2 miles southwest of the town of Lloydminster, was not immediately followed up, but during the last year wildcats as far distant from the discovery as 8½ miles west and north and 3½ miles southerly have found oil, and the field extends into Saskatchewan. The wells are not large producers and the oil is similar to oil from Vermilion, being about 14 deg. API. A Petreco plant has been installed to remove sediment and salt water, and the oil is sold to the Canadian National Railways for engine fuel on the mountain divisions.

TABLE I

Canadian crude oil production including natural gasoline, bbl. (From Dominion Bureau of Statistics and Alberta Petroleum and Natural Gas Conservation Board.)

	1944 12 months	1944 first half	1945 first half
Turner Valley	8,326,314	4,181,340	3,859,940
Jumpingpound	0	0	1,977
Vermilion	234,603	108,642	127,275
Lloydminster	6,296	1,431	11,937
Wainwright	17,154	8,640	7,375
Taber	148,638	76,860	74,400
Conrad	24,733	0	36,378
Princess	13,815	0	22,152
Red Coulee	3,835	3,835	0
Other fields	13,338	6,365	3,902
Alberta total	8,788,726	4,387,113	4,145,336
Northwest Territories	1,229,310	569,784	309,799
Ontario	130,302	67,719	53,273
New Brunswick	22,968	11,221	13,403
Canada total	10,171,306	5,035,837	4,521,811

[2]F. K. Beach, *The Petroleum Engineer*, October, 1944, page 114.

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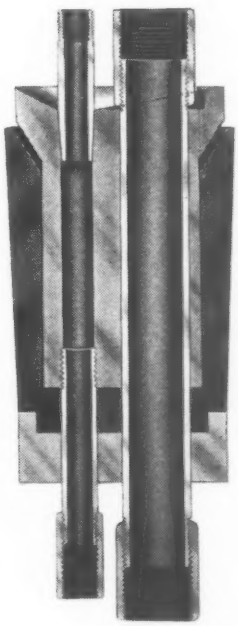

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In inexpensive Robinson "Special"—used to pack off water from leaky casings.

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For creating flows in new wells–for packing off water in leaky casings.

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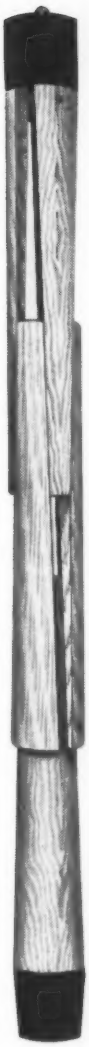

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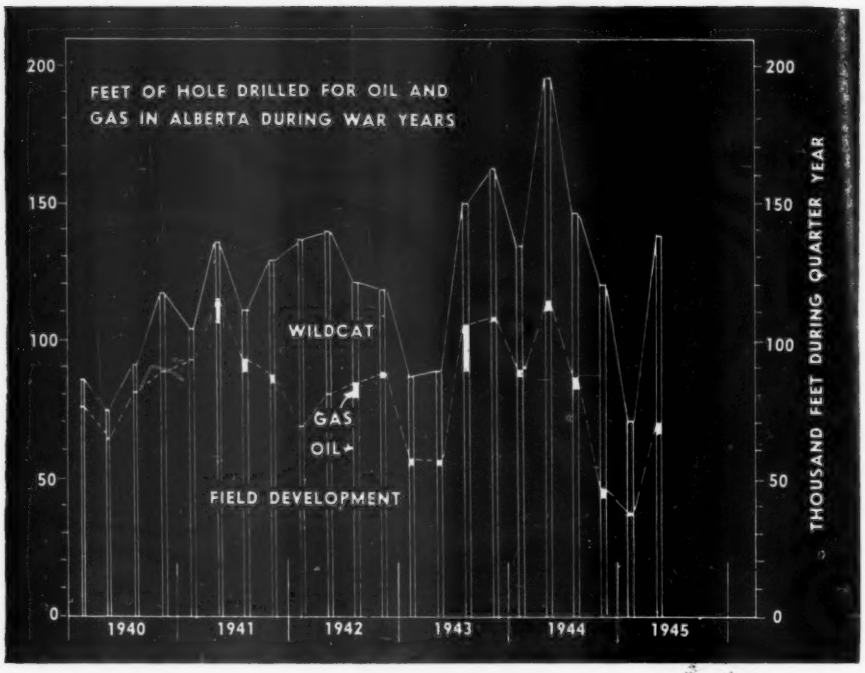
Alberta Wildcats

The deepest test in the province of Alberta has just been abandoned, Imperial Coalspur 1 on 10 of 3, 49-21, W.5, was carried to 12,955 ft., reaching the Madison at 12,756 ft. before difficulties forced abandonment. At 10,430 ft. 7-in. casing was cemented and a 4¾-in. liner was set at 12,776 ft. Tests were made by gun perforating, and owing to collapse of casing the information gained was not so great as desired. There was no sign of oil in commercial quantity, although there was indication of gas.

Home Brazeau Syndicate is drilling about ½ mile northeast of the test abandoned by Home in 1940 after reaching a depth of 8728 ft. The present well is a joint venture of several companies and is currently drilling below 8000 ft.

Imperial and Shell are drilling a test near Stolberg, about 25 miles southeast of Home Brazeau, and are currently below 6700 ft. Diamond drilled in 1942, a well on Ram River in the Brazeau area got a nice showing of oil in the Devonian, and encouraged further development so that 2 or 3 operations have been active in that vicinity.

In developing Turner Valley, a fault block to the east of the main production was found at a considerably lower depth and it contained oil at elevations much below water level as found on the west side of the field. This fault block has not proved to be extensive and several tests to the east of the fault block have explored the Rundle in the less disturbed parts of the geosyncline flanking Turner Valley to the east, but without success. Imperial and Anglo Canadian have just begun a well about 25 miles north and a little west of Calgary in the geosyncline, the location being based on seismic work.



Home Brazeau Syndicate 1, in unsurveyed territory, about 5 of 17, 43-17 W.5. An interesting wildcat currently drilling below 8500 feet.

For those who are interested in particular areas being explored or tested, and that are not touched on here, the Petroleum and Natural Gas Conservation Board in Calgary, Alberta, has publications that may be obtained. A yearly report lists all drilling licenses issued for oil and gas wells, summarizes completions, and publishes the production by months of every oil well. A "Schedule of Wells to 1944" lists every well that was drilled to the end of 1944 and gives a brief of geological markers except for wildcats drilled in 1944. A geological correlation table in color is also available, and maps showing location of wells that have been drilled, prepared on a scale of 4 miles to the inch, are available as ozalid prints. On application to the Board a price list of publications will be sent to those interested.

Tar Sands

The bituminous sands along the Athabaska River continue to lure the imagination of an oil hungry country. The quantity of hydrocarbons contained in them is great enough to warrant interest, but the performance of plants erected to exploit them has been disappointing. The Dominion Government has probably spent $1,250,000 in the Abasand venture near Waterways. Some separation operations were carried on this year with recovery of 11,437 bbl. and the plant was about ready for test when a fire on June 16 destroyed the separation plant and some adjacent buildings, though the refinery was spared. Early in July, it was announced that Abasand would rebuild and continue operations without government assistance, but no start has as yet been made, and a recent news item suggests that some discussions are still under way. The Alberta Government has also made some commitments in connection with Oil Sands, Ltd., an operation some distance down the river from Waterways, and the Alberta Research Council is supplying supervision of those opera-

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Remember, there is an "American" service man in every active field!

tions. Dr. K. A. Clark of the Alberta Research Council has covered the subject quite fully in a recent article[3].

Another occurrence of tar sands has been known for some years at Buffalo Narrows, in northern Saskatchewan, between Churchill and Peter Pond lakes, and recently interests at Kamsack, Saskatchewan, took out a 3-year prospecting lease with option of converting it to a 20-year exploitation lease.

Saskatchewan

The Imperial Oil Company and its affiliate, the Norcanols Oil and Gas Company of Winnipeg, have operated continuously in Saskatchewan since the spring of 1939 and during that time have done extensive surface geological field work, gravimetric work, and seismograph work supplemented by widespread shallow structure test drilling. In all, approximately 25 per cent of the desirable prospecting ground in Saskatchewan has been evaluated by these surveys. As a result of the geological and geophysical exploration, 11 deep tests have been drilled but, unfortunately, to date none has yielded results of commercial importance. The deepest of these holes, Norcanols—Ogema No. 1, reached the Precambrian basement complex at 9390 ft. Several others penetrated the Winnipeg sandstone formation of Cambro-Ordovician age.

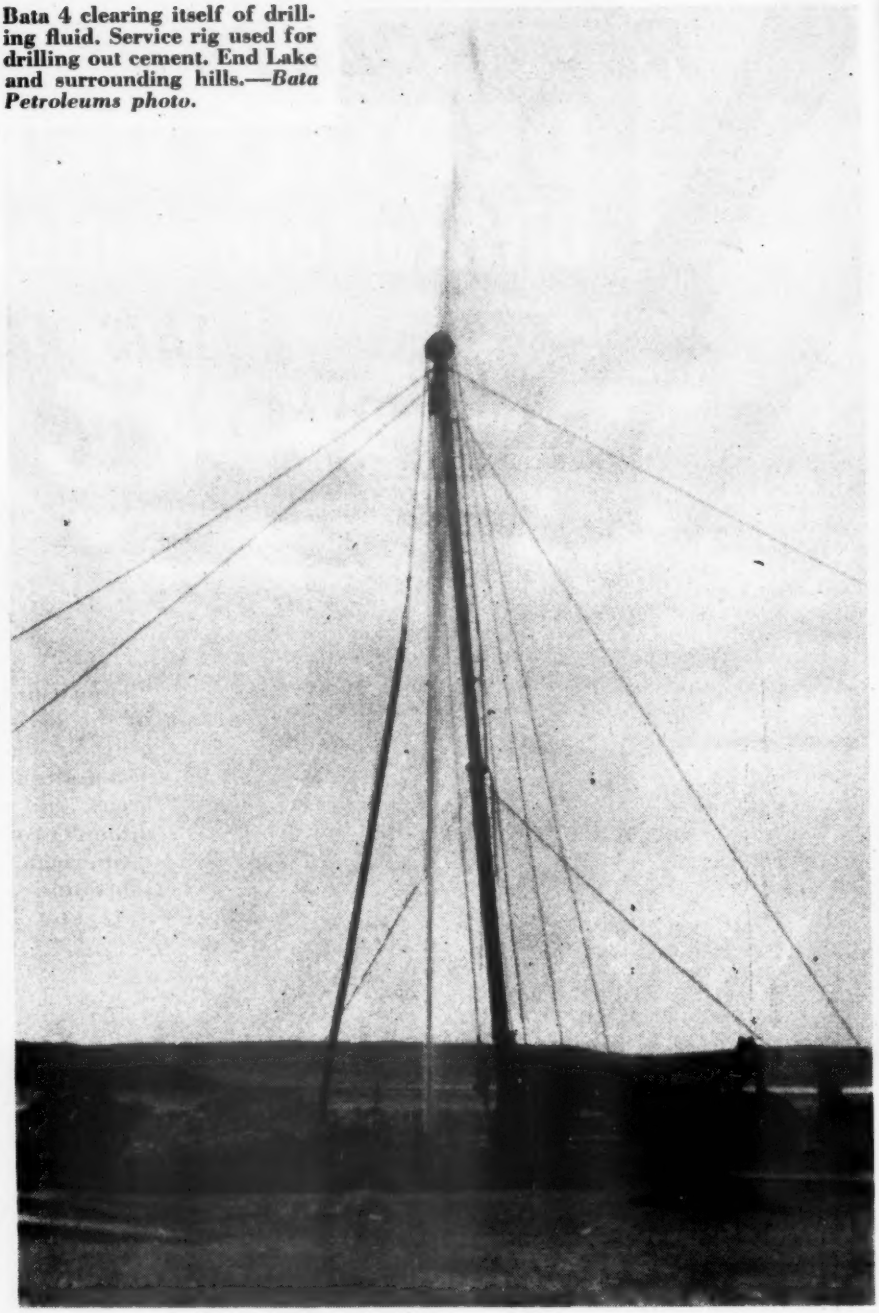
Bata Gas Field

Bata Petroleum, Ltd., a company financed largely by Saskatchewan capital, drilled a well last year in search for oil about 6 miles south of the village of Unity, Saskatchewan. It was about 1½ miles from an old well drilled by Northwest Company, a subsidiary of Imperial, as Muddy Lake No. 1, about 1920-22. The Muddy Lake well apparently was located because of gas seepages and from the fact that some gas had been noted in water wells and had even been used locally. The Muddy Lake well reported some gas showings, including one that must have been low in the Colorado shale at about the horizon of the Viking sand, which has proved to be a good gas reservoir in Alberta.

Bata No. 1 was a dry hole (see map Fig. 3). No. 2, also drilled last year, was about 1½ miles north, and obtained a nice flow of gas with open flow of about 1500 M. cu. ft. per day and bottom hole pressure of 695 lb. per sq. in. from the Viking sand at 1635 ft. Drilling was carried to the Devonian, which was reached at 2095 ft., and about 15 ft. of limestone core bled a little oil but did not prove productive. The gas discovery, however, led the company to consider using it as a supply for the town of Unity, which has a population of 800 and is only 5 miles distant. No. 3 well, some 4 miles NNW of No. 2, found no sand in this zone and only a showing of gas from sandy shale. No. 4, drilled in May of this year ¼ mile north of No. 2, found a flow from the Viking sand measuring 3600 M cu. ft. per day and the well was completed just below the Viking sand for a total depth of 1659 ft.

[3]*Oil Weekly*, August 13, 1945.

Bata 4 clearing itself of drilling fluid. Service rig used for drilling out cement. End Lake and surrounding hills.—*Bata Petroleums photo.*



Its success encouraged further exploration.

No. 5, a mile north of No. 2, had no Viking sand and was abandoned after the test had gone 28 ft. into the Devonian with negative results. No. 6, half a mile north and half a mile east of No. 2, drilled in July of this year, had an open flow from the Viking sand of about 750 M. cu. ft. per day. No. 7, ¾ mile SW of No. 2, showed 1200 M cu. ft. per day through ¼-in choke. The Viking sand was higher structurally than No. 2, so it was carried to the Devonian, where another gas sand was found in the Lower Cretaceous that tested 3900 M cu. ft. per day and at higher pressure than the gas in the Viking sand. No. 8, about a mile west of No. 2, found gas in both these sands. No. 9, a mile south of No. 8, confirmed gas in both these sands and was completed from the Lower Cretaceous as a gas well with a large open flow. Further exploration is going on to outline the limits of the field and determine the reserves.

The city of North Battleford, population 4800, is about 50 miles northeast of the field, and Saskatoon, population 43,000, is about 110 miles east and a little south. Franco Oils obtained a franchise to sell gas in Saskatoon but they have not as yet developed enough gas to warrant building a pipe line.

Dr. J. O. G. Sanderson is geologist for Bata Petroleums, General Petroleums, Ltd., of Calgary is drilling contractor, and Denton-Spencer Company, Ltd., acts as engineering adviser. Unity Gas Supply Company has been organized to transmit and retail gas in the village of Unity, and Denton-Spencer Company, Ltd., is also engineers for the Unity company.

Decision on marketing in a larger center than Unity has not yet been made

13,000'
14,000'
SCHLUMBERGER

pending more complete data on the available reserves. For the purpose of such estimate the Viking sand is considered to be 3½ ft. thick, although 6 ft. of pay has been found in some wells. An average of 4 wells shows porosity of 21 per cent, permeability of 83 millidarcys and surface pressure is taken as 630 lb. per sq. in. The Lower Cretaceous sand is taken as 5 ft., with perhaps 9 or 10 ft. in some wells. Porosity is 27 per cent (only one sample determination), permeability of 400 millidarcys, and surface closed pressure of 715 lb. We are indebted to J. F. Langston, MEIC, of Denton-Spencer Company, Ltd., for these data.

Saskatchewan Production

The only oil production obtained in Saskatchewan has been from 1 or 2 wells in Lloydminster field, offsetting production developed in the Alberta side. A total of 3483 bbl. was produced from 2 wells, April to July, and a third well began producing in August. Lloydminster town has been supplied with natural gas for several years, and up to the end of 1944 it is reported that consumption has aggregated 1,005,968 M cu. ft., the supply coming from 5 wells. Pressure is rapidly decreasing in the field.

Near Kamsack 50 or more shallow wells have found gas and it has been used by farmers and distributed to domestic consumers. The field pressure is only about 25 lb., so the operation is not of great importance.

Other wells recently drilled in Saskatchewan include:

Bobjo Mines Alameda 1, in 1 of 4, 5-2 W2; abandoned at 3344 ft. in Jurassic.

Bobjo Mines Moose 1, in 2 of 30, 9-16 W2; abandoned at 1700 ft.

Boundary Horsham 1, in 10 of 26, 17-29, W3; completed at 3516 and standing. Oil showings in Ellis sand 3154-64 ft. Top of Devonian 3170 ft.

Palo 1, in 11 of 36, 36-17 W3; standing at 1995 in Lower Cretaceous.

(Saskatoon) Aberdeen Oil and Gas Company 1, in 9 of 6, 39-2 W3; abandoned in Palaeozoic at 1791 ft.

Community Services 4, in 9 of 10, 49-28 W3; completed at 1882 ft. with some oil and gas showings in Lower Cretaceous sands, but no production. (This adjoins Lloydminster field).

National Grant 1, in 4 of 14, 49-28 W3; completed at 1872 ft. in Lower Cretaceous. Oil production began about March, 1945, at 30 bbl. a day.

SAC 1, in 12 of 2, 49-28 W3; began producing oil recently from sand at 1880 ft.

White Fox 1, near Torch River, in 5 of 14, 52-15 W2; recently reported drilling in Palaeozoic limestone at 805 ft.

Northwest Territories

The Canol pipe line, which was put into operation on April 30, 1944, was closed down in March, 1945. Deliveries at Whitehorse have not been disclosed, but during 3 years ended in March, 1945, about 1,750,000 bbl. were produced from the field at Norman wells, most of which was available for dispatch through the pipe line. Of this total, nearly 1,250,000 bbl. was produced in 1944, an average of about 3400 bbl. a day, and during the peak month the yield was more than 4350 bbl. a day. The impression is gained that production was held to about the pipe line capacity. The capacity of the line was estimated at 3000 bbl. a day, but it has exceeded that amount. Total reserves of oil in the field are estimated at 30 to 60 million bbl.,[4] so the field can be ranked as of major importance. Prior to its development to meet a strategic need, it had been operated for a number of years as a source of gasoline for bush flying and river transportation, and to supply fuel for mining operations. It is to be expected that such demands will continue in the future, and it is quite possible that the scale of mining operations may increase in the postwar period, thus calling for increased gasoline and fuel oil.

At the end of March, 1945, the field had 63 producible wells. Norman Wells field is undersaturated with gas and a gas collecting line was laid and all possible gas produced with the oil was returned to the upper part of the field as part of a policy of pressure maintenance. At present only 2 wells are being produced intermittently for local supply of oil and fuel gas.

War is a wasteful operation. If we were to judge the value of the Canol project by the standard of total cost divided by barrels delivered at Whitehorse, the project can be classed with war in general as a wasteful operation, justifiable only by the necessities of military economics and logistics. There are some credit items of an intangible nature, however. Some thousands of men have acquired first hand knowledge of a terrain that otherwise would be almost unknown, and their acquaintance with this territory may result in opening up much habitable land to settlement. Geological reconnaissance has been carried out along the Alaska highway and the Canol road, as well as along some of the rivers made accessible by those developments. The Geological Survey of Canada has already issued maps and papers describing the areas and from them it seems probable that commercial metal mines may result from prospecting along some of the route, and that there may be petroleum possibilities in other areas. Oil companies have put geological parties into the field this year to cover some of the adjacent country.

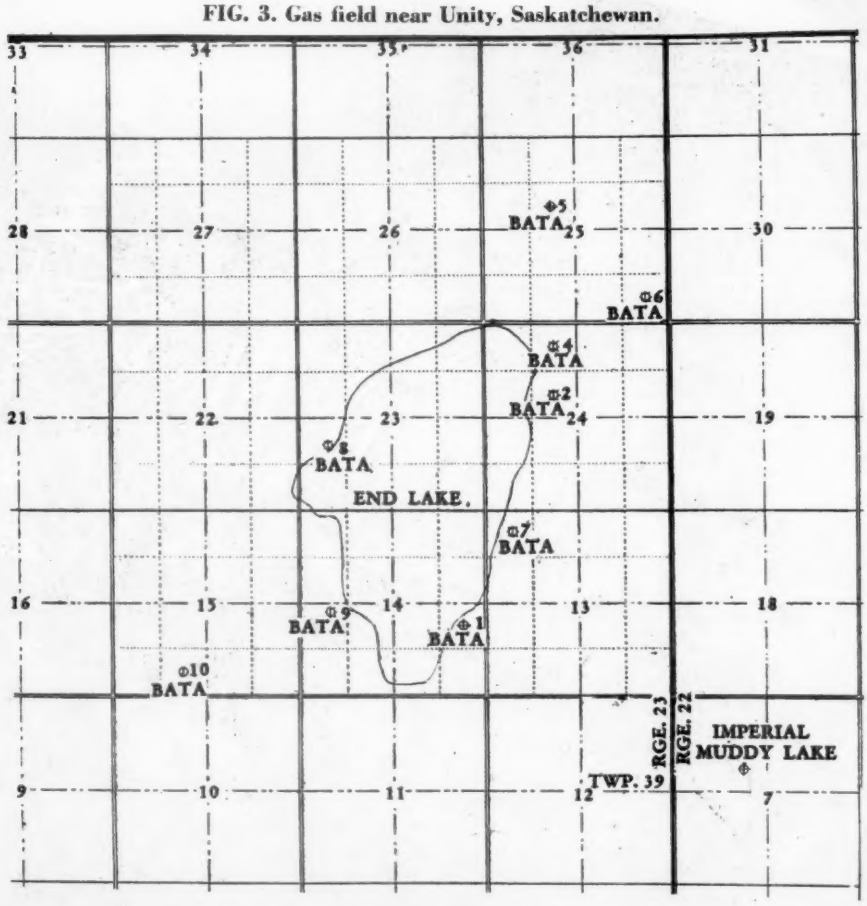
These credit items certainly are intangible at the moment. Should they prove of positive value, they will accrue to the benefit of Canada rather than to the United States, who paid the shot, but owing to the rather free intercourse between the two countries, the potential values are open to citizens of either country who go to search for them.

Geological and Geophysical Surveys

Alberta, Northwest Territories, and the Peace River Block in British Columbia are being systematically searched by a number of American and Canadian companies. This summer there were some 14 or 15 seismic parties working,

[4] F. K. Beach, *The Petroleum Engineer*, October, 1944, page 108.

FIG. 3. Gas field near Unity, Saskatchewan.



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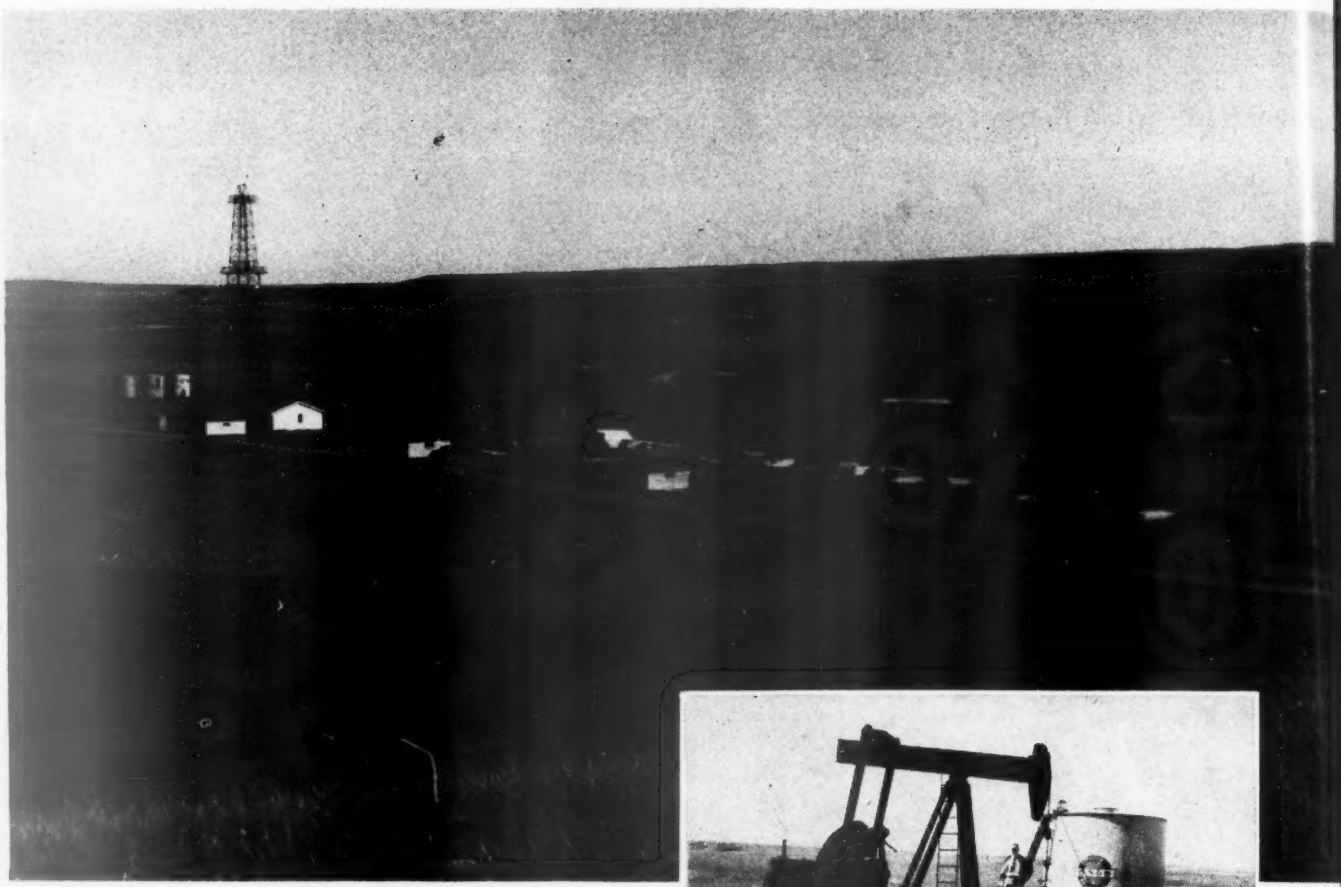

Conrad Province 13-5-A and start of California Standard camp. Camp will include several residences, warehouse, office, etc. In the distance at right can be seen a trace of pipeline trench climbing the hill on the far side of Etzikom coulee.—*California Standard photo.*

Pump jack and tank at Conrad Province 37-5-A and E. A. Brock, pipeline engineer from Standard Oil Co. of California.—*California Standard photo.*

several gravity meter and quite a number of geological parties, and in this respect 1945 appears to be the most active to date. In addition, a cooperative enterprise subscribed to by a number of companies is making aerial photographic surveys of the foothills belt. Considering the difficulties of surface travel in much of this belt, surface geology can be mapped much more rapidly and efficiently by this method, and it is hoped may assist in oil finding.

Companies participating in surveys in Alberta and Northwest Territories include Imperial (subsidiary of Standard Oil of New Jersey), California Standard, Shell, McColl Frontenac (Canadian affiliate of The Texas Company.) Socony-Vacuum, Gulf, British American, Phillips Petroleum, Sun, Pure Oil, and Rio Bravo (subsidiary of Superior Oil of California).

In addition to work by private companies, the Geological Survey of Canada has maintained parties in the field and publishes preliminary papers, issued as mimeographed reports and blue print maps, and later puts out lithographed maps in color. During the war some of the publications have been delayed, but a start has been made in adding to the published data. A recent "Revision of the Lower Cretaceous of the Western Interior of Canada" by F. H. McLearn, publishhed as Paper 44-17, Second Edition, contains in addition to the mimeographed report, 12 pages of photographic reproductions of key fossils.

Natural Gas Developments

Northwestern Utilities, Ltd., operating the Viking-Kinsella field some 110 to 120 miles southeast of Edmonton and distributing gas in Edmonton and intervening towns, has recently been looking for franchises in towns and villages between Edmonton and Red Deer. Proposals were made several years ago to extend their lines to serve this area, but shortage of steel during the war prevented carrying out the project. It is probable that this work will go ahead now that war priority demands for steel are disappearing.

If all the franchises sought are approved at forthcoming plebiscites, the towns and cities of Camrose, Wetaskiwin, Ponoka, Lacombe and Red Deer, with an aggregate population of 11,000 will be served, and the projected pipe line will involve 67.3 miles of 8-in. pipe, 29.8 miles of 6-in., and 6.1 miles of 4-in., plus distribution mains, fittings, and meters.

Turner Valley, which contained Alberta's biggest gas reservoir, and from which more than a trillion cubic feet was wasted incidentally to recovery of condensate and crude oil, is now being brought under a conservation plan and some 600,000,000 cu. ft. was injected into the gas cap in July, 1945, alone, with another 100,000,000 cu. ft. injected into the Bow Island field. Waste for the same month was reduced to 670,000,000 cu. ft.

A public utility hearing has been under way for some months at which all interested parties may make representations and at the close of which the Natural Gas Utilities Board will decide the price to be paid for stored gas, conserved gas, and gas sold to the market, and will decide the distribution of costs between these classes of gas and natural gasoline. The Board is composed of G. M. Blackstock, K.C., and Dr. E. H. Boomer. Blackstock also heads the Board of Public Utilities Commissioners of Alberta, and Dr. Boomer also heads the Petroleum and Natural Gas Conservation Board, and the Departments of Chemical Engineering in the University of Alberta.

Some 9,000,000 cu. ft. of natural gas from Turner Valley is going daily to Alberta Nitrogen Products for manu-

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facture of ammonium nitrate fertilizer and anhydrous ammonia. The plant was erected by the Dominion Government when there were threats that enemy action might destroy British explosives plants. Actually those threats never materialized, but the capacity of the plant was fully employed for military purposes. Some time ago the output was gradually diverted, due to the shortage of fertilizer, and is still manufacturing the fertilizer. There is no immediate indication of future plans for the plant and in the meantime it is an important consumer of natural gas.

Norcanols Radville 2, in 16 of 36, 5-19 W.2 near edge of Missouri Coteau, a Pleistocene moraine. Glacial kettle in foreground used as mud sump. Well was abandoned last year at 5121 feet in the Madison limestone.—*Photo by J. C. Sproule.*

Alberta Spacing Rules

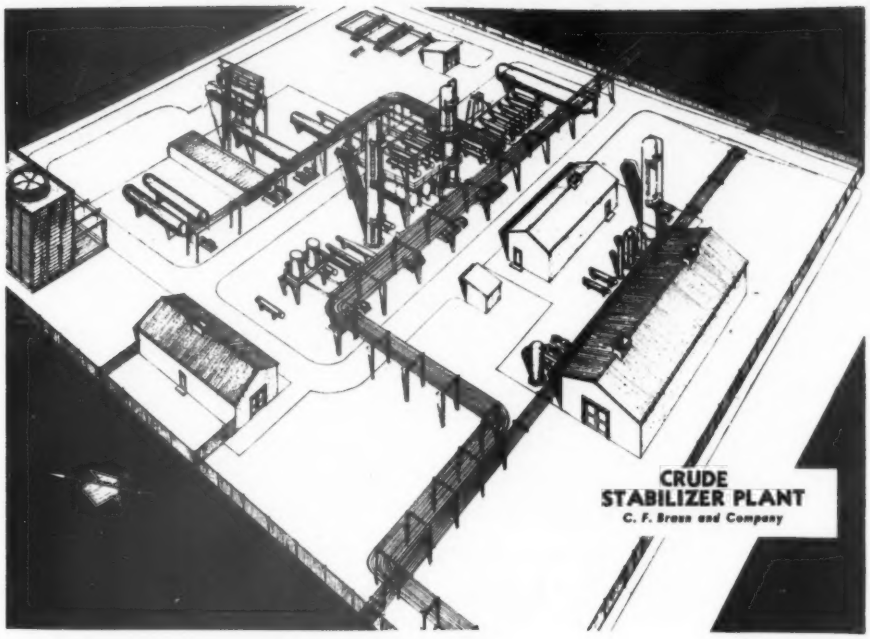
The Petroleum and Natural Gas Conservation Board has wide powers over drilling and production operations with [illegible] Alberta. Among the powers is that [illegible] regulating the spacing of wells. For Turner Valley, where ownership of leases [illegible] held by many owners, the spacing pattern is 1 well per legal subdivision (40 acres), and this seems to fit the economic picture where drilling depths approach 10,000 ft. and most wells are deeper than 6500 ft. The field has a gas drive yielding high gravity oil. In Vermilion, with depths to production of about 1800 ft., a 10-acre pattern has been approved, matching low gravity crude in a pumping field. In some other fields a pattern of drilling, say in the southeast 10 acres of each legal subdivision, contemplates eventual increase to a pattern of 2 or 4 wells to the 40 acres. In gas fields a pattern of 1 well to the section has been the practice of late years, and is likely to continue until it is shown that the economics and subsurface conditions warrant any closer spacing. As mentioned in a previous paragraph, the unitized Jumpingpound field will begin with an 80-acre pattern in the proved oil area, and the contract calls for only 1 well to the square mile in the gas cap. The contract was drawn with consent of the Board, and it does not preclude increase in number of wells in the oil area up to 1 well per 40 acres, should that policy prove to appear economical, although the depth to the oil suggests that economics may work against such close spacing.

Quality of Gasoline

During the war the Oil Controller reduced the number of grades of motor gasoline to two, and reduced the octane number of those grades below what had previously been customary in order to provide large supplies of high octane for aviation. Rationing was removed simultaneously with the lifting of rationing in the United States and at the same time the industry was permitted to increase octane number so long as prices remained static. There was an immediate improvement in quality of gasoline performance.

Alkylation plants built during the war have quite a capacity for 100-octane production and the alkylate now on hand is the property of the Dominion Government. There have been no indications regarding its future disposition. The Montreal plant already has been shut down.

British American Oil Company with head office in Toronto recently announced purchase of the assets of Union Oil Company of Canada, including 220 retail outlets in British Columbia and 77 in Alberta, together with some wholesale facilities and a site suitable for erection of a refinery close to Vancouver. This acquisition strengthens the position of British American, giving it some 4000 retail outlets across Canada. It has five Canadian refineries with daily throughput capacity of 41,500 bbl., and its facilities include the manufacture of lubricating oil as well as gasoline and illuminants. ★ ★ ★



VENEZUELA POSTWAR PROGRAM INCLUDES REFINING AND REPRESSURING PROJECTS

By **JOHN H. KUNKEL,** *Refinery Editor*

EXCLUSIVE

With the end of the global war assuring availability of the necessary materials, the interest of many petroleum engineers in the western hemisphere centers in Venezuela where a postwar program calling for the erection of 4 modern, sizable refineries within the next 5 years is about to get under way, and where a pressure maintenance plant construction program of considerable magnitude already has begun.

As the total capacity of the 4 new refineries will approximate 135,000 bbl. per day, the completion of this phase of the program will make Venezuela a world factor in refining, whereas the pressure maintenance program will assure maintenance of the crude production rates and increased crude production from the fields served. Processing of wet gas will result in recovery of substantial quantities of light hydrocarbons.

Creole Petroleum Corporation, the Venezuelan affiliate of Standard Oil Company (N. J.), Sinclair Refining Company of Venezuela, Mene Grande Oil Company, S. A. (Gulf), and Caribbean Petroleum Company (Shell) will erect the new refineries in conformance with agreements entered into with the Venezuelan government in 1943. Creole, Sinclair, and Mene Grande each will erect pressure maintenance plants.

Creole's Refinery

Creole's new refinery will be erected at Turiamo in the State of Aragua at a cost of $50,000,000. Its capacity will be 40,000 bbl. per day and its end products will include aviation gasoline, motor gasoline, kerosine, industrial lubricants, automotive and marine diesel fuels, lubricating oil of many types, greases, industrial and marine bunker fuels, and asphalts.

A fluid catalytic cracking unit will be the heart of the new refinery. A definite decision has not been made regarding the other units of the refinery, but a tentative plans call for these to include an atmospheric pipe still, a thermal reformer, a vis-breaker, a non-selective polymerization unit and treating facilities. Storage facilities will consist of a 4,000,000-bbl. tank farm while utilities will consist of an electric power plant and a water treating plant.

Of the $50,000,000, a total of $10,000,000 will be expended in the construction of a model community consisting of houses for employes, schools, a hospital, churches, sports field, clubhouses, shopping facilities, and necessary roads.

Turiamo is situated on Turiamo Bay about 20 kilometers east of Puerto Cabello by water, and 64 kilometers northwest of Maracay by road. It is 31 kilometers from Ocumare de la Costa with which it is connected by road.

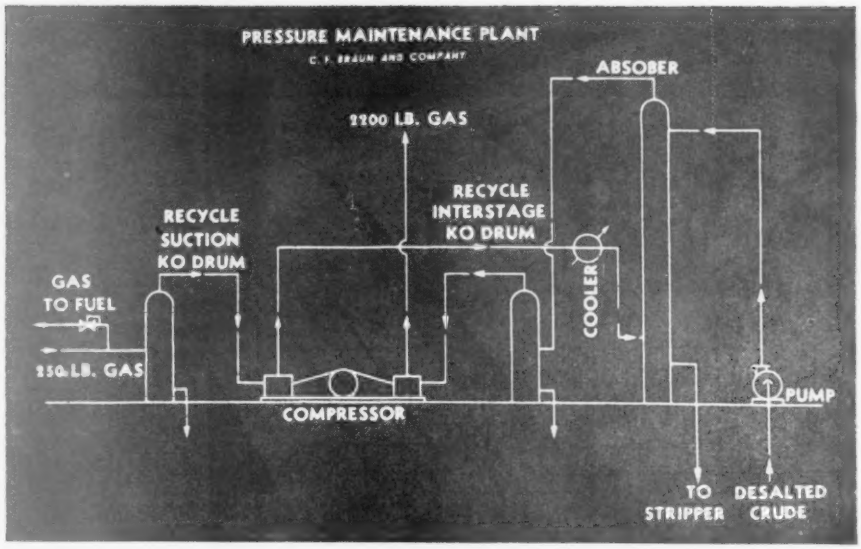
After the site was decided upon, the company immediately launched plans for construction, and it is anticipated that such work as road building, site clearance, and the construction of nu-

JUSEPIN CRUDE-STABILIZER PLANT

The plant-buildings shown in sketch above are designed to satisfy certain requirements that Creole considers basic. The operators must be comfortable in all seasons. The housed machinery and the instruments must be protected from the weather and from airborne-dust. The buildings must be economical to build and to maintain. Building-appearance must be pleasing to the eye.

Separate buildings are provided for control house, switch house, and compressors. These buildings have structural-steel rigid-frames with roofs of galvanized iron. The walls are hollow-tile. The exterior finish is white stucco.

All buildings have forced-ventilation with filtered-air. Drinking water is electrically refrigerated. The control house includes, in addition to the control room proper, laboratory, change room and toilet, and two offices. Steam cooker and coffee-maker are provided.



Simplified flow diagram of Creole's pressure maintenance unit.

merous facilities required by the refinery itself will begin before the end of the year. It is estimated that 2 years will be required to build the refinery and place it on stream, and with V-J day so closely following the selection of the site, Creole officials undertook a study of the possibilities for beginning actual construction of the refinery at the earliest possible date.

Nearly 1000 men will be required to build the refinery. When finished it will employ 1600 men. It is estimated that employes and members of their families will constitute a community of between 6000 and 8000 persons.

Pressure Maintenance Project

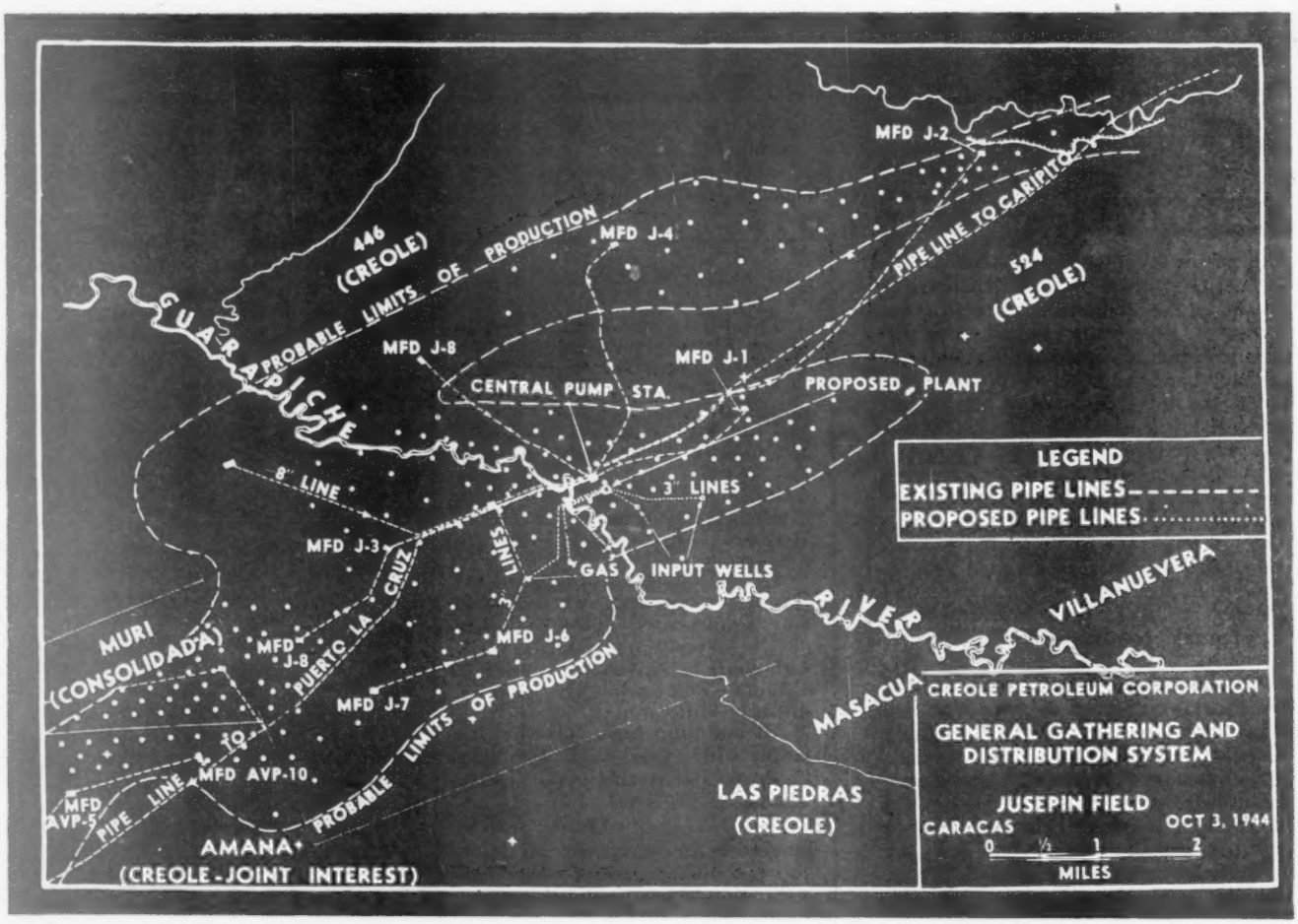
Creole's new pressure maintenance plant will be situated in the Jusepin field, State of Monagas, Venezuela. It will consist of a combination crude stabilization and pressure maintenance unit, crude desalting facilities, and an additional 55,000-bbl. floating roof storage tank. The existing field production system, storage facilities, and product pipe lines will be used. The plant will represent an investment of $2,500,000. Construction will be underway in January, 1946, and the plant is scheduled for completion by September of that year.

The Jusepin field was discovered in 1939. As of February, 1945, two hundred and three wells had been completed in the field, and, of that number 193 were oil producers with a total potential production of about 50,000 bbl. per day at an average gas-oil ratio of about 1150 cu. ft. per bbl.

The sands of the field are reasonably continuous, with good porosity ranging from 20 to 30 per cent, but with low permeability of the order of 100 millidarcies. The field has excellent structural relief. The existence of any known barriers, either sedimentary or structural, preclude the possibility of water drive. Also, some degree of gas segregation has already been noted as high gas-oil ratios are now prevalent among the structurally high wells.

Under this condition, pressure maintenance is expected to increase recovery from approximately 25 per cent of the oil in place to 35 per cent or more. Creole's interest in developing Venezulea's crude reserves in accordance with modern conservation methods dictated the decision to install the pressure maintenance unit. The plant will return 10,000,000 cu. ft. of gas per day to the main Jusepin sand, this total representing the full gas output of the plant.

The plant facilities will include two



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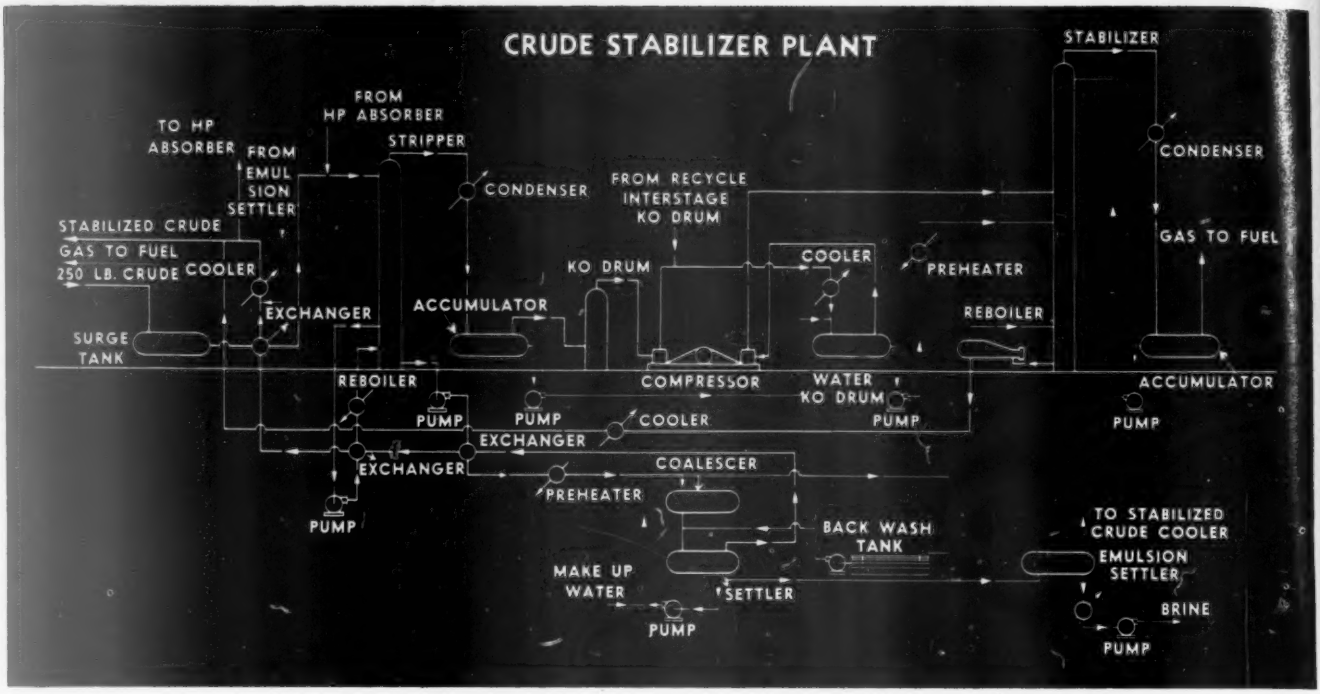

Simplified flow diagram of Creole's crude stabilization and desalting plant in Jusepin field.

2-stage gas-engine-driven 800-hp. compressors with an inter-stage absorber for the recovery of light hydrocarbons. Injection of the gas to the main Jusepin sand will be through 5 existing wells at a pressure of about 2200 lb. per sq. in. gage*.

Due to the crude stabilization section of the plant, field production as delivered to tankers from that portion of the field served by the project, will be increased from 40,360 bbl. per day of 32.0-deg. API, 6-lb. Reid vapor pressure crude to 41,780 bbl. per day of 33.6-deg. API, 9-lb. Reid vapor pressure crude. The 1420-bbl.-per-day increase will result from the stabilization of light ends formerly unavailable, from the reduction of evaporation losses through installation of the floating roof storage tank, and from reduction in vapor pressure of the product to storage from 70 lb. to 9 lb., the net recovered product being essentially C_4 and heavier in the gasoline boiling range.

The desalting section is designed to permit desalting of Jusepin crude from 60-100 lb. per 1000 bbl. to 15-20 lb. per 1000 bbl. by means of water washing and settling under pressure. This reduction in salt content will almost entirely eliminate off-stream time for the removal of deposited salt in refinery units processing Jusepin crude, and the replacement of equipment resulting from chloride corrosion.

The pressure type of desalting facilities was selected due to the advantage of reducing salt content without loss of the crude's lighter ends as would be the case if open heating combined with chemical treatment were employed.

Flow

The existing field gathering and distribution lines will be used. Wells will be produced through new separators at 250 lb. at each of the 11 existing field flow manifolds. Weak wells will be produced at 100 lb. through existing separators, and oil injected into the 250-lb. separators' outlet lines by means of vacuum-type traps. The 250-lb. separators will discharge through existing lines to a new central field manifold in the plant area.

The crude flow through the stabilization and desalting unit in the plant is to a surge tank where the crude is flashed at 100 lb. Bottoms from the surge tank flow through a transfer line into which steam is injected before the bottoms pass through primary heat exchangers against stabilized desalted crude to storage.

The transfer line from the surge tank meets bottoms from the inter-stage absorber in the pressure maintenance section and, in common with the raw crude feed, the flow is to the 20-lb. stripper.

From the primary exchangers flow is to a 20-lb. stripper served by a reboiler where the crude's light ends are stripped and, as overhead, go to a condenser and then to an accumulator.

Flow from the accumulator is to a suction knockout drum on which a two-stage, gas-engine-driven 800-hp. compressor takes suction to increase the pressure of the stripper overhead to 350 lb.

The feed to the 30-tray light ends stabilizer consists of the total overhead from the crude stripper. The overhead from the stabilizer is condensed, passed through a water-cooled condenser to a reflux accumulator on which a reflux pump takes suction to reflux the stabilizer over the top tray. Gas flashed off the accumulator goes to fuel or flare.

Bottoms from the stabilizer pass through a gas-fired reboiler and then go to storage, in a common line with the stabilized desalted crude.

Desalting

A desalting section feed pump takes suction on the stripper bottoms to pass them through tertiary exchangers against stabilized desalted crude and then through a preheater to a sand bed coalescer.

Upstream of the coalescer an emulsion is formed by mixing the denuded crude from the stripper bottom with 50 per cent by volume of recycled brine to which 3 per cent by volume on crude of deaerated make-up water is continuously added.

Desalting is accomplished by passing the emulsion through the sand bed coalescer and thence to a brine settler. The overhead from the brine settler as desalted stabilized crude meets the stabilizer bottoms, passes through the tertiary, secondary and primary exchangers to storage.

Pressure Maintenance Section

Wet gas at 250 lb. from the field enters the pressure maintenance section at the rate of 20,000,000 cu. ft. per day, of which 10,000,000 cu. ft. per day goes to fuel. The remaining 10,000,000 cu. ft. per day flow to recycle suction knockout drum on which a 2-stage, 800-hp. compressor takes suction to increase the pressure to 750 lb. before passing the gas through a compressor intercooler and thence to an interstate absorber. Desalted crude from the crude stabilization section will be employed in the absorber as the absorbent medium.

Bottoms from the absorber join the stabilization section stripper feed as previously mentioned. The absorber overhead passes a second stage compressor in which pressure of the gas is raised to 2200 lb. for reinjection to the main Jusepin sand.

*Unless otherwise stated all pressures are in pound per square inch gage.

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Sinclair's Projects

Sinclair's new refinery will be built in fulfillment of its agreement with the Venezuelan government, and lack of PAW approval is the only thing that delayed construction. As early as 1943, Sinclair sought approval for its construction, but due to the war and the urgent need for materials in the huge U. S. refinery expansion program, the needed approval was withheld.

Sinclair's original plan called for a 35,000-bbl.-per-day refinery with 100-octane aviation gasoline, toluene, Navy fuel oils, diesel fuel, and lubricating oils as the end products. Then the objective was to devote the refinery's make to the war effort, but the sudden termination of the war has, of course, changed the end products, but capacity will be 35,000 bbl.

Although Sinclair has not made any announcement as to the components of its refinery, it is understood that the site has been selected and final decision regarding the new refinery's units soon will be made. The refinery's probable output will be aviation gasoline, motor gasoline, Navy fuels, lubricating oils, and other peacetime products.

The site of the refinery is Puerto la Cruz, which has the advantage of being the terminus of Sinclair's 70,000-bbl.-per-day pipe line from the company's Santa Barbara field in Eastern Venezuela. Puerto la Cruz also is said to be one of the finest of South American harbors.

As in the case of Creole, Sinclair will build a modern, model community. It will feature houses varying in architectural design and appearance. Sinclair is committed to begin construction of the refinery by not later than 1951, but with the availability of materials it is thought construction will begin well before that date.

Pressure Maintenance, Absorption

Compania Consolidada de Petroleo, the operating subsidiary of Venezuelan Petroleum Company, is constructing a pressure maintenance and absorption plant in the State of Monagas, Venezuela, to serve its Muri and Santa Barbara fields. The plant not only will process the gas produced in these fields and return dry gas to the producing formations, but it also will stabilize and top a certain amount of motor fuel from the crude, and generate electric power for the site and camp. It is expected that the plant will be completed by mid-January 1946.

Natural gas, produced with the crude, will be piped from the various gathering tank battery separators situated throughout the Muri and Santa Barbara fields to the plant at a pressure of approximately 50 lb. where it will enter scrubbing tanks to remove all liquids and entrained foreign matter. From the scrubbers the gas will pass through 3 stages of compression, which will increase its pressure to approximately 2200-2500 lb. at which pressure it will be returned to the formation through input wells. The gas plant will consist of seven 600-hp. gas-engine-driven compressor units having a total daily compressor capacity of 18,000,000 cu. ft. of gas.

Between the first and second compressor stages, after being cooled, the gas will pass through an absorption tower having a daily processing capacity of about 25,000,000 cu. ft. in which the recoverable hydrocarbons will be extracted. After second-stage compression, the gas will be cooled in a high-pressure dehydrator to free the gas of all humidity before its final compression to approximately 2200 to 2500 lb. for return to the producing formation.

The crude oil will be stabilized in special separator tanks and such gases as are freed in this operation will be mixed with the natural gas to the absorption plant and treated as previously described. The capacity of the crude stabilization unit will be approximately 60,000 bbl. per day.

The absorbent medium used in the absorption plant will be circulated in the absorber and distillation system. Fat oil from the absorber bottom will pass through thermic recuperators and preheaters to a flash tower in which the lighter hydrocarbons will be separated, and the balance of the absorbent will pass through a vertical still for separation of the remaining hydrocarbons from the absorbing medium, which is recycled as lean oil back to the absorber.

The lighter hydrocarbons separated in the flash tower together with the heavier from the still will be condensed to form natural gasoline. Excess vapors not condensed in the operation will pass through a reabsorber. From the condensers the natural gasoline will go to a stabilizer, and thence to horizontal storage tanks. The plant will also recover propanes and butanes.

Crude Topping

In addition to the gas plant, the installation includes a small crude topping unit consisting of a vertical, preliminary distillation still with its corresponding heat exchangers, condensers and coolers, and a vertical recuperation still to produce the absorbing medium used in the gas absorption plant as well as motor fuel.

A crude oil treating unit is also a part of the installation. This consists of 2 separator tanks to remove gas and sediment, a water settling tank, and 2 final settling tanks. The capacity of the treating unit is 20,000 bbl. per day.

Water suitably treated for use in the plant will be obtained from wells close to the plant site. Four 150-lb. boilers will provide steam for the plant, and three 600-hp. gas engines will generate electricity for the plant and general use of the company.

The plant will be equipped with all the auxiliary equipment and facilities required by the installation such as pumps, cooling towers, oil coolers, office building, warehouse, laboratory, garage, locker rooms, showers, sanitary installations, fire alarms, fire fighting equipment, etc. Control switches will be placed at strategic points throughout the plant by means of which the entire plant can be shut down in case of emergency.

Although the plant is primarily a pressure maintenance unit to prolong the flowing life of the field and increase ultimate recovery, it will also manufacture 1000 to 1500 bbl. per day of natural gasoline and conserve gas produced with the oil.

Gulf's Projects

At the time of writing, Mene Grande, the Gulf affiliate in South America, has not reached a decision regarding the components of either its refinery or its pressure maintenance plant and both are in the preliminary stage.

It is known, however, that Mene Grande is committed to the erection of a 20,000-bbl.-per-day refinery and according to its agreement with the Venezuelan government, the refinery must be on stream by January, 1951. The site of the Mene Grande refinery will likely be at Puerto la Cruz.

Mene Grande's pressure maintenance plant will be situated in the Officina district. Currently, the plant is being engineered and plans call for the processing of wet gas for recovery of the lighter hydrocarbons before the denuded gas is returned to the producing formation.

Caribbean Project

Caribbean Petroleum Company, a Shell affiliate, also will construct a 40,000-bbl.-per-day refinery in Venezula at a cost of $35,000,000. Caribbean's agreement with the Venezuelan government calls for construction within 5 years after close of the war, or 5 years after materials become available.

The refinery make will include aviation gasoline, motor gasoline, and lubricating oils. Other elements of the project include a complete community with homes, hospital, sports fields, and terminal loading facilities. The site selected for the refinery is near Punta Cardon on the southwestern part of the Paraguana peninsula east of the Gulf of Maracaibo.

★ ★ ★

Will test law

Magnolia Petroleum Company has leased 129,025 acres of land extending 30 miles into the Gulf of Mexico from the State of Louisiana. The lease will test a law passed in 1938 that asserts the state may exert "effective authority" for the 30-mile range of modern cannon. Tradition has established as the limit of national authority 3 miles into the oceans. Magnolia's venture will prove what other countries will accept. The Federal Government, until recently, was a contender for tideland rights, but congressional committee approval of a resolution gave states what amounts to a quit claim on submerged lands. Louisiana has 650,000 such acres believed to hold oil deposits.

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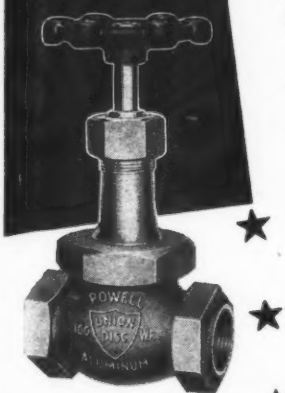

Fig. 1853 — Aluminum Globe Valve with screwed ends, union bonnet, and renewable vulcanized composition disc. Can be supplied with 18-8S stem.

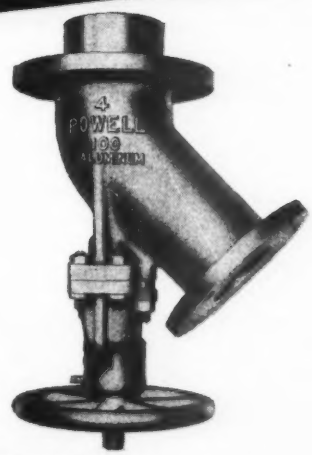

Fig. 2309A—Aluminum Flush Bottom Tank Valve for attaching to metal tanks and autoclaves. Also available with 18-8S disc, stem and seat plate. In this design the disc rises into the tank to open the valve.

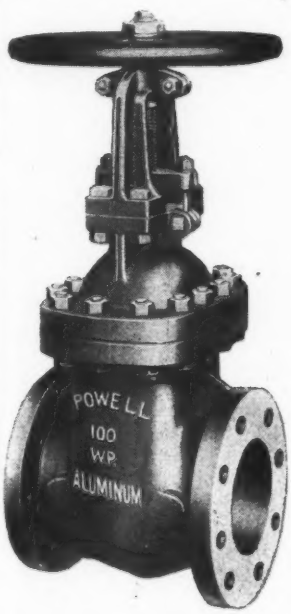

Fig. 2461—Large size Aluminum Gate Valve with flanged ends, bolted flanged bonnet, outside screw rising stem and taper wedge double disc. Can be supplied with 18-8S disc and stem.

Fig. 1859— Aluminum Gate Valve. Screwed ends, screwed-in bonnet, inside screw rising stem and taper wedge double disc. For more severe service, we recommend 18-8S disc and stem.

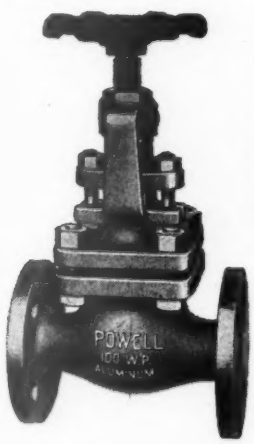

Fig. 1946 — Aluminum Gate Valve with flanged ends, bolted flanged bonnet, and outside screw rising stem. Taper wedge double disc in sizes 1" and larger. Also available with 18-8S disc and stem.

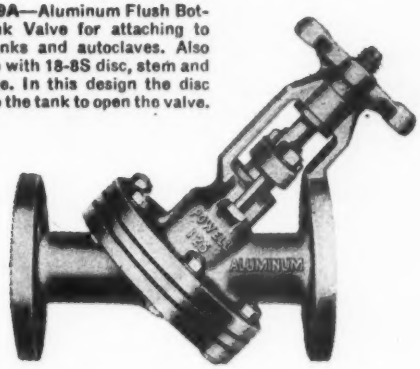

Fig. 1097A—Aluminum Separable Body Reversible Seat "Y" Valve. Also available with 18-8S disc, stem, lock nut, gland and seat plate. Lower half of the body can be unbolted and turned through an arc of 180 degrees to make a 90-degree angle valve, for special piping arrangement and to eliminate extra fittings.

*ALUMINUM VALVES are particularly well adapted for handling glacial acetic acid, acetic anhydride, ammonium hydroxide, concentrated nitric acid, hydrocarbons and distilled water. They also have a special application in food processing and dispensing, in the manufacture of naval stores, and in plants where non-sparking materials are required.

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P 615.92

INGENUITY USED TO LAY INDIA-CHINA PIPE LINE

IN the building of the world's longest pipe line from India to China, necessity mothered so many inventions that nothing seemed impossible to the American pipe-line engineers. The pipeliner's ingenuity played an important role in the delivery by July 30 of this year of 120,139,132 gal. of petroleum products through the pipe-line system to combat troops in Burma, road builders, and convoys traveling over the Stilwell Road.

In May, 1944, a party of pipeliners camped on the south bank of the Tawang River in Burma were cut off from their base at Shingbwiyang by monsoon floods. Pipe-line construction faced a temporary halt unless transportation could be devised.

A good V-8 motor was stripped from a wrecked Bren gun carrier, along with other salvageable parts including some armor plate. A 10-ton aluminum ponton was begged from a nearby ponton company. The motor was mounted in the 10-tonner. A driveshaft and universal were cannabalized from a defunct 2½-ton 6 by 6 truck and run back through a piece of 4-in. invasion pipe to an improvised propeller cut from the armor plate.

From the gun carrier came the steering wheel to make up the finished product. Within a short time the marooned men were plying across the 1000-ft. wide stretch of water of the rushing Tawang in a boat capable of carrying 40 lengths of pipe, 3½ tons of cargo, or 42 men.

TRUCKS supplied by the Army for hauling pipe were of the ordinary, 6 by 6 cargo variety, not ideal for the job, for the pipe's overhang at the rear put a severe strain on the vehicle. A GI with logging experience was convinced that he could build a semi-trailer similar to the type used for hauling logs in the U. S. Pacific Northwest.

He welded two truck bodies together and mounted them in the back of a lengthened 2½-ton engineer trailer. The completed semi-trailer revolutionized the method of hauling pipe in Burma and China. Where only 68 joints of pipe could be hauled in one vehicle before, the trailer could haul 178 joints. In addition, this equalization of the load distribution lengthened the life of the truck. Within a short time all pipe-line companies had equipped themselves with similar trailers.

Jeeps proved too small to handle the

Pipe tongs made by pipe liners.

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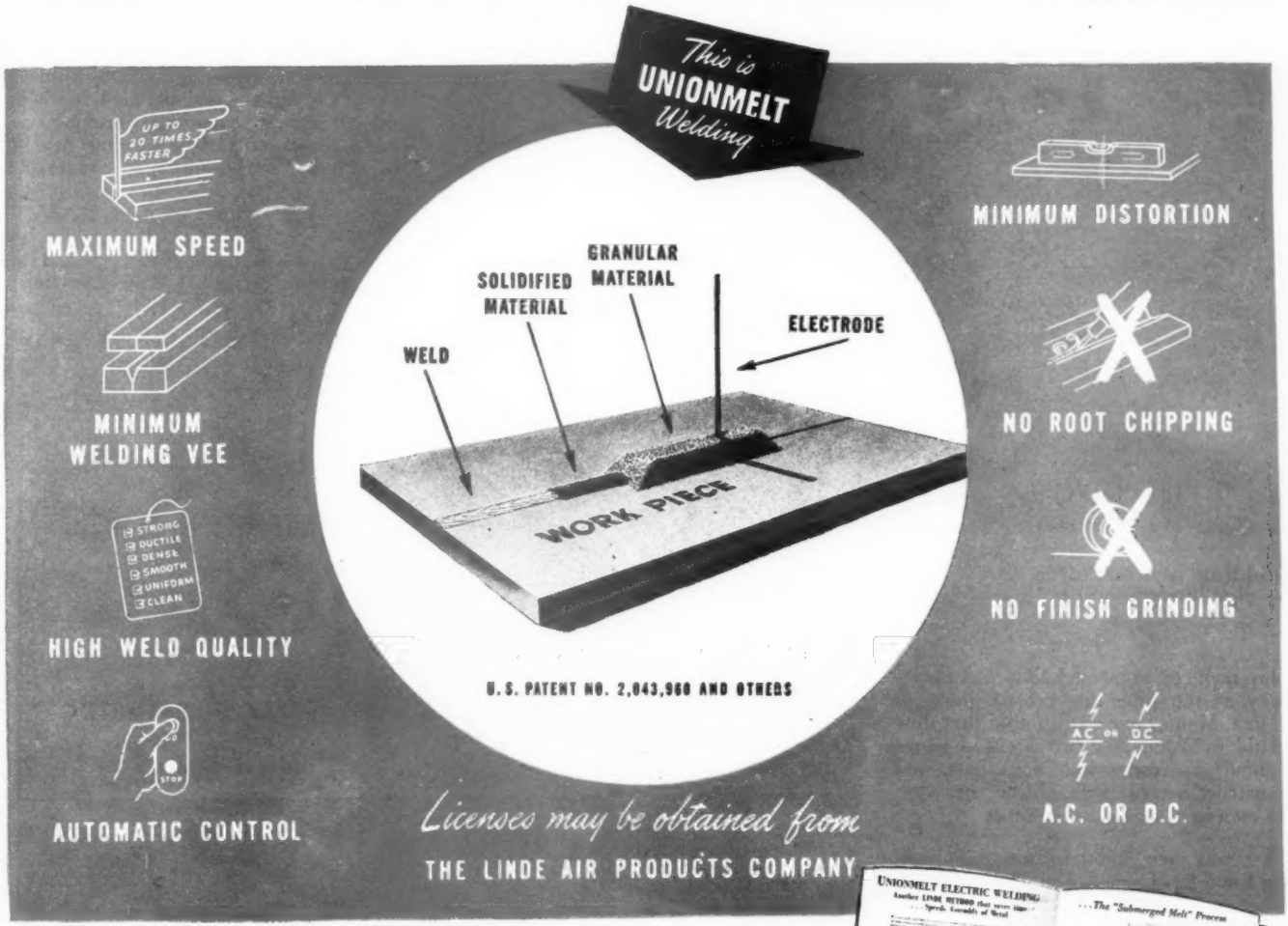

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Welding plant made by pipe line engineers.

movement of personnel that was necessary as the pipe line moved along in China. Men of one outfit found that they could weld together two wrecked jeeps, extend the frame and crankshaft, and construct a vehicle capable of carrying 18 men in comparative comfort.

An area near Kaimang was inundated by 4 to 6 ft. of water. The pipe could not be coupled together in such a lake. Undaunted, the pipeliners coupled together 600-ft. lengths of pipe, plugged the ends to make the sections float, and towed them into place to be coupled with other similarly built sections. Several miles of pipe line were coupled in this way.

When an area became so muddy that trucks could not negotiate it, pipe-line sleds were built from heavy weight pipe and Japanese steel plate. Huge tractors pulled the loaded sleds through the mud, and pipeliners laid the pipe as they went along.

Bending pipe in the jungle was another difficult task. Lightweight invasion pipe could be bent by hand, but this often crimped the joints. A GI took a hydraulic lift from a wrecked dump truck, fitted it to a curved metal shoe, mounted it on trailer made from reinforced heavy pipe, and wound up with a mechanism that could safely bend the pipe to any desired angle. The device could be operated by one man, and was light enough to be hauled through the jungle manually in areas that trucks could not negotiate.

At times the pipeliners were forced to get pipe and supplies across raging torrents that had not been bridged. Cables were slung across the rivers and supplies were trollied over in slings. To get equipment and personnel across the Logali River a cable 1000 ft. long was slung 400 ft. above the water.

Protection of pipe laid on the beds of rivers whose racing waters carried crushed rocks and other debris downstream was difficult until a pipeliner devised a scheme to take a 2½-yard power shovel from a road engineer company, connect cables to it, and winch it back and forth from one side to the other until a ditch several feet deep was built underwater to protect the pipe from damage.

In the Mogaung Valley of Burma it was found that trace for the pipe line could not be cut with knives and machetes. Elephant grass 14 ft. high resisted the efforts of the trace clearers until a truck driver thought of tying a huge teakwood log to the back of his truck and dragging it behind the surveyors. The grass snapped off at the roots, and a few days later was dry and ready to be burned.

One of the most spectacular bridges along the Stilwell Road was built by the pipeliners to span the Salween Gorge in China. It is a foot bridge 700 ft. long, built entirely of salvaged Japanese and Chinese equipment. The pipe was laid across this bridge and engineers still walk across its dizzy heights to service the line.

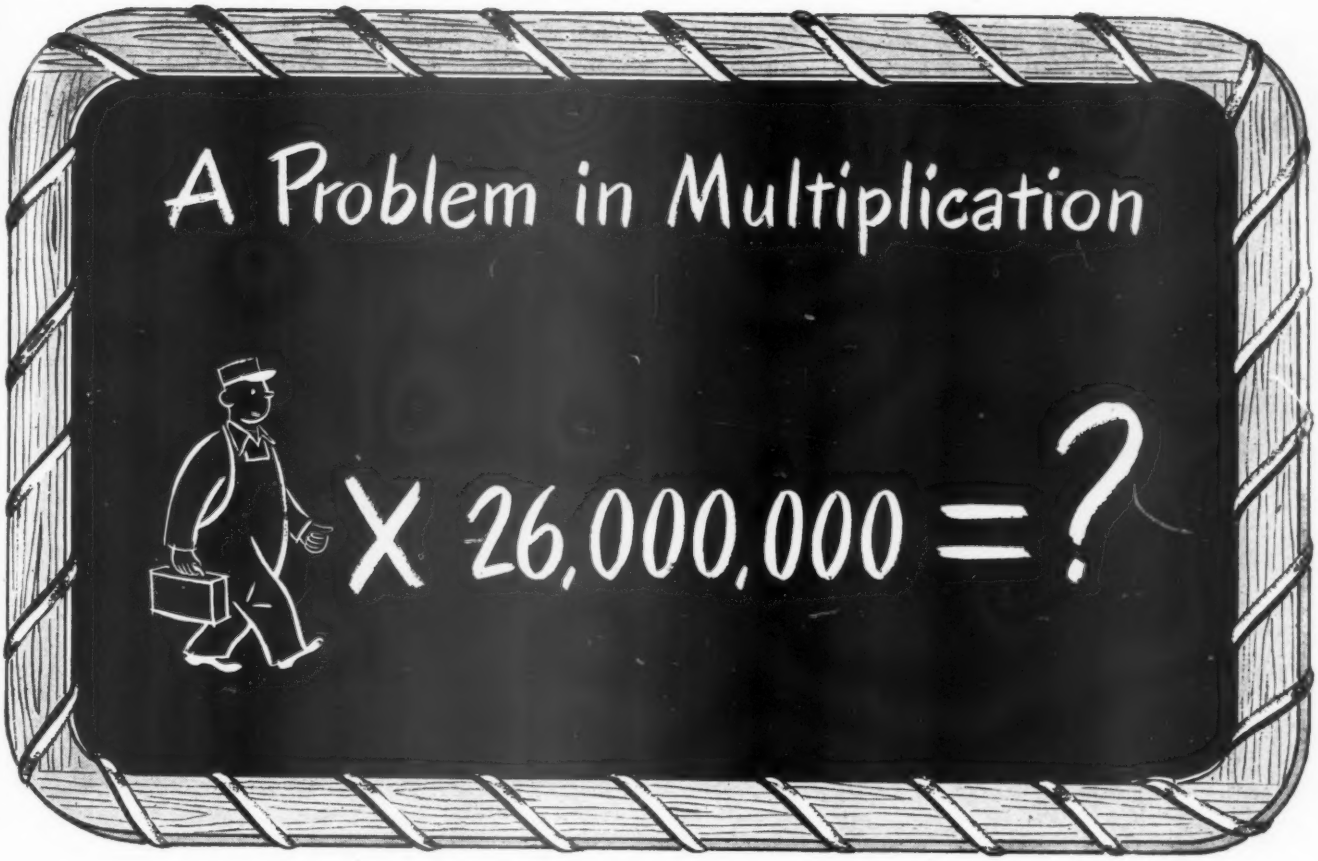
Everything the pipeliners came across was put to some use. Jap 150-mm. shell cases formed a firm foundation for storage tanks in muddy areas. Tools were manufactured in the field. Army rubber boots were utilized to make gaskets when special gaskets for gate valves along the line did not arrive. Old gasoline drums that needed rewelding were dangerous because of the gas fumes that remained behind after the fuel had been used. An old boiler taken from a sugar mill was repaired and put in service steam-cleaning the drums before they were welded.

Improvised sawmill that aided in building India-China pipe line.

Some of the ingenuity displayed by the pipeliners went into improving their own comfort. One outfit built its own water system supplying running water to every tent. Not long after the fall of Myitkyina an imaginative soldier found some old parts in the city's wreckage and built an ice plant that delivered 1600 lb. of ice to his company each day. A sawmill was built from salvaged material by a man who had never seen a sawmill before. One soldier had an air conditioned tent within a mile of a crude Naga village.

According to Colonel Birney K. Morse of Swarthmore, Pennsylvania, who was in charge of the forward pipe-line construction, GI ingenuity as much as anything else was responsible for the success of the record breaking pipeline construction job in India, Burma, and China.

★ ★ ★



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PIPE LINE ACROSS ISTHMUS OF PANAMA

By **WILLIAM A. COBLENZ,** Bureau of Yards and Docks

EXCLUSIVE

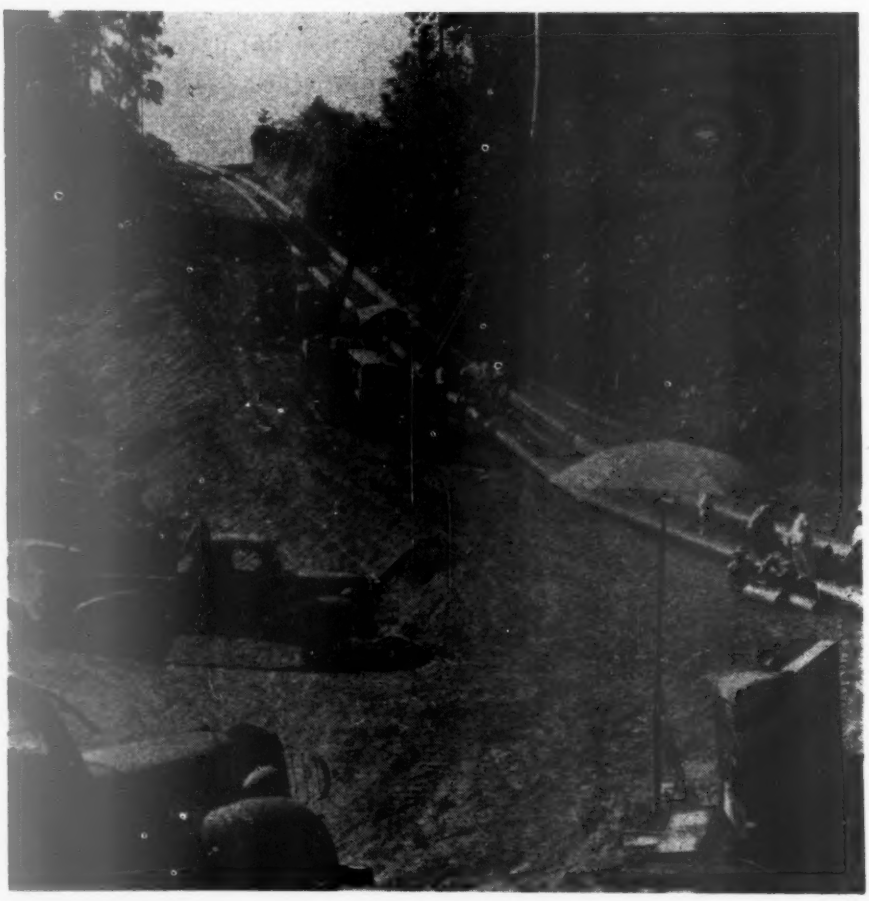
How the emergency construction of a pipe line across the Isthmus of Panama in the darkest hours of the war liquidated a three-way threat to the safety of the American continent just came to light in information released by the Navy's Bureau of Yards and Docks. This, says the Bureau, is the $20,000,000 pipe line now almost entirely finished across the Isthmus, roughly parallel to the Panama Canal, from Cristobal on the Atlantic side, to Balboa on the Pacific. The threat it forestalled came from three directions, each of which, at the time, was regarded in the highest army and navy circles as extremely critical.

There was the always present danger that the Canal itself might be made inoperative by enemy action. There was the secondary danger that the Japanese enemy, installed on Kiska, might plunge down through the Pacific Coast, which would have been his move, Naval authorities anticipated, had the strategic Battle of Midway been lost by the Americans. There was also the third and final threat of the loss to the United Nations of the oil fields of the Persian Gulf and Iraq had the German armies succeeded in driving on through southern Russia. At the time of the pipe line's construction any one of these eventualities teetered on the edge of the probable, and the enemies' success in any one of these campaigns would have immobilized the Pacific fleet by rendering it devoid of fuel.

The pipe line was constructed through the jungles of the Canal Zone as the result of an exchange of secret communications between the Secretary of the Navy and the Secretary of War. In July, 1942, the Wehrmacht was moving so swiftly across Europe, beyond Sevastopol, that the oil fields in the Persian Gulf area and Iraq were already beginning to be plugged up in anticipation of German seizures. The Germans never got that far, but it looked as if they would. The Pacific fleet was getting some of its fuel oil requirements from these sources. Failure of these sources meant that greater pressure would be placed on the American sources in the Gulf of Mexico and Caribbean area and this again called for instant enlargement of facilities. In July, 1942, high officials described the strategic urgency for the pipe line "an immediate military necessity."

This "jugular artery" of the Pacific fleet runs for 46 miles all told from the Atlantic to the Pacific. The original intent was to have it serve as an alternate supply route only in case any one of the three threats materialized. The need for fuel and other oils and gasoline became so acute as the war progressed, however, that the pipe line, in its earliest construction stages, was put into use. Its capacity was more than doubled by building a duplicate pipe line parallel to it.

Men laboring under torrid sun of Panama to complete fuel pipe line from Cristobal to Balboa.—*Official U. S. Navy photograph.*



The pipe line has a daily capacity of more than 350,000 bbl. of petroleum products. This capacity is sufficient, according to experts, to keep the Pacific fleet mobile and supplied with oil even should the Panama Canal become useless. In August, 1942, the project was taking form as the joint effort of the Chief of Naval Operations and the War Department. After a secret meeting of some 20 officers of the Army and the Navy, responsibility for the construction of the pipe line was delegated to the Chief of the Bureau of Yards and Docks, Vice Admiral Ben Moreell, CEC, USN.

The $20,000,000 construction job includes, besides the pipe line proper, terminal facilities, piers, ballast water plants, and pumping stations. Although the original pipe line had been long since completed, the additions and extensions to provide greater capacity and flexibility of operation was reported in the latter part of July, 1945, as more than 95 per cent complete.

Williams Brothers Corporation, of Tulsa, Oklahoma, did the job under Navy contract. The area of operations is within the 15th Naval District. It was supervised for the Bureau of Yards and Docks by a group of Civil Engineer Corps officers under direction of Captain Edward D. Graffin, CEC, USN, and Commander John A. Scoville, CEC, USN.

Its primary effect during wartime operations in the Panama Canal was to send highly combustible fuels shooting through safe pipe lines under the earth, and free the Canal from the risks and dangers inherent in this type of cargo.

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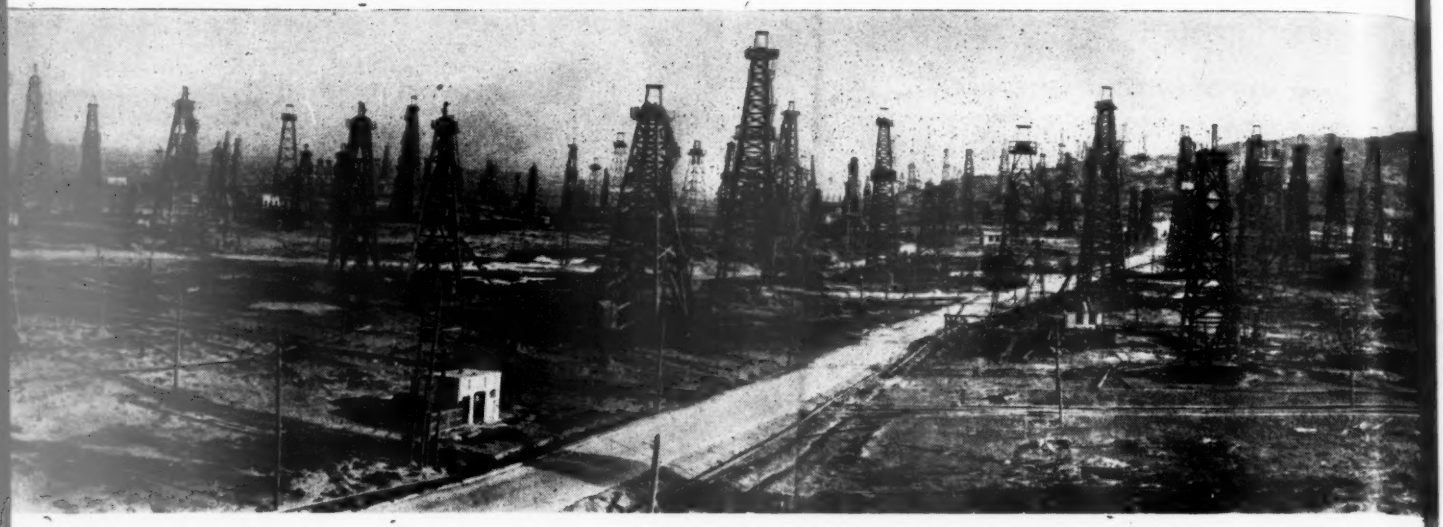
OIL MINING MARINE MUNICIPAL INDUSTRIAL



L. Kaganovitch fields, a forest of derricks. *Acme photo.*

DOING BUSINESS WITH RUSSIA

By **E. C. ROPES,** *Chief of Russian Unit*

U. S. Bureau of Foreign and Domestic Commerce

FOREIGN trade in the U.S.S.R. is a monopoly of the Soviet Government. The Soviet Union thus provides the first instance in modern history of a State in exclusive control of all exportation and importation of goods. This control is exercised by means of export and import licenses, which are issued to the Soviet trading agencies by the commissariat for foreign trade in accordance with the import and export program or Plan, which is formulated each year in advance by the state planning commission in Moscow. Although there is a complete system of import duties, they play no part in encouraging or restricting imports, which are governed by the licenses issued.

● **Trading corporations.** The trading agencies responsible for the actual exportation and importation of goods are called "combines." These Soviet corporations by Soviet law are legal entities, independent of the government, but directed by the foreign trade commissariat. They function as channels through which all movement of goods across frontiers takes place, are divided and named (in Russian) according to the kind of goods exported or imported, and are represented abroad by the trade delegation in a particular country, such as England or France, or by a special corporation established in accordance with the laws of the country concerned. The combines place their orders through the trade delegation or corporation, or act in conjunction with it sending their own representatives to the country in question. A list of these combines, with a description of the commodities for which they are the sole export and import channels, appear in the appendix.

Soviet agencies in the United States. During the war, the Soviet Government Purchasing Commission in Washington has been handling all orders for military and other goods shipped under the Lend-Lease Act. With the cessation of hostilities, the activities of this commission are expected to come to an end.

In peacetime, the sole Soviet purchasing and selling agency in the United States, except for small corporations handling films, photographs, books, and music, is the Amtorg Trading Corporation, at 210 Madison Avenue, New York 16, New York. This enterprise, founded in 1924, is incorporated under the laws of the State of New York; all but a few shares of stock, however, are held in escrow in Moscow by the Bank of Foreign Trade. The Amtorg (abbreviation, in Russian, for American Trading Company) is the "purchasing and sales agency in the U.S.A. for import, export, and industrial organizations in the U.S.S.R.," with a main office in Moscow, and as such may be made legally responsible for the acts of its principals, by provision in a contract.

Shipping. The Amtorg cooperates closely with the "Sovtorgflot" (Soviet Merchant Fleet) of Moscow, which owns and operates the Soviet merchant marine, and charters foreign bottoms as they are needed. When shipping cargoes or goods from Atlantic coast ports, the Sovtorgflot, through the Amtorg, utilizes the services of Moore and McCormack, New York, New York. This firm receives and loads goods consigned to Soviet buyers, charters United States boats, and performs other services. The Sovtorgflot also charters ships of the American Export Lines, New York, New York, when cargoes are destined for Black Sea ports. The Soviet Government also uses its own vessels on trips between West Coast ports and Soviet Far Eastern ports.

Insurance. The Amtorg insures all cargoes or shipments of Soviet-owned

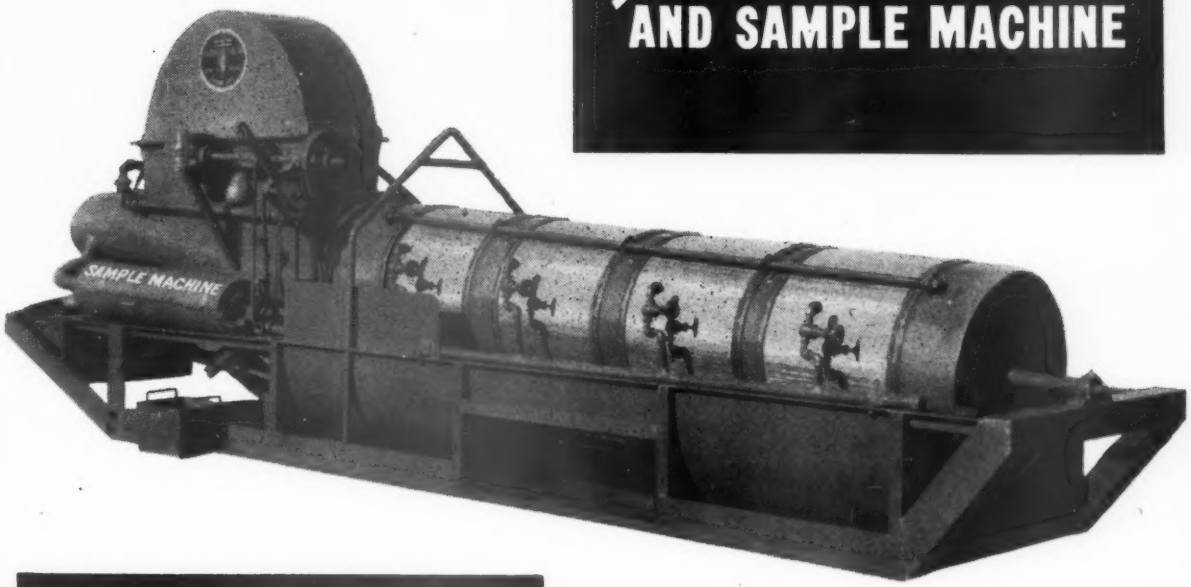
Foreword

This report, one of a series on how to conduct business in various countries, presents information on the agencies of the Soviet Union that engage in foreign trade, and the customary manner in which contracts are arranged and payments made for goods purchased by the U.S.S.R. It also contains information on employment and living conditions in the Soviet Union of value to prospective representatives and technical assistants of firms in the United States the activities of which may take them to that country.

The study was prepared in the Russian Unit under the direction of Mr. Ernest C. Ropes, Chief.

AMOS E. TAYLOR, *Director,*
Bureau of Foreign and Domestic Commerce.

THE *Thompson* SHALE SEPARATOR AND SAMPLE MACHINE



PROVIDES ACCURATE FOOT BY FOOT SAMPLES OF CUTTINGS!

THE THOMPSON SHALE SEPARATOR, which operates entirely from the flow of mud, eliminates destructive abrasives, saves and protects critical drilling equipment and materials. This machine is considered the most economical and simplest method of removing shale from mud while drilling, and should be a standard part of your modern drilling equipment.

The SAMPLE MACHINE, which is standard equipment on all Thompson Separators, unless otherwise specified, is a test proven method of securing true samples of cuttings and sand, valuable in geological research. Operates from main power wheel of the separator.

This machine represents only a very small investment and will pay for itself in savings alone within a very short time!

THOMPSON TOOL CO.
IOWA PARK, TEXAS

THE SHALE SEPARATOR THAT *Really* HANDLES THE LOAD!

KEEPS DRILLING MUD *CLEAN* — PROVIDES *TRUE SAMPLES* OF CUTTINGS

goods with the "Gosstrakh" (State Insurance Company) of Moscow, which operates through the Black Sea and Baltic Insurance Company, an English-Russian firm domiciled in London. Risks usually are reinsured with British companies.

Inspection. Inspection of goods ordered by the Amtorg usually is made by Amtorg or other Soviet inspectors at the purveyor's factory. On the basis of this inspection, after adjustment of any disagreements between buyer and seller, formal acceptance is issued by the Amtorg, and the goods are shipped. Inspection also has been entrusted in special cases to some United States firm of qualified engineers whose report is final.

Terms. Contract terms of payment between the Amtorg and a seller in the United States have varied considerably during the existence of the former, from cash before shipment from factory, to 2½ years or more from date of shipment. Immediately before the second World War, standard terms of payment were 45 days after shipment of goods.

The terms usually extended by a particular firm in the United States to a foreign selling agent, or to a professional exporter, may also be applicable to sales to the Amtorg or other Soviet purchaser. It should be noted that the Soviet buyer does not resell for his own profit, but distributes directly to the ultimate user of the goods who is an agency of the Soviet Government.

Payment. Payment is made on the basis of the shipping documents. Usually the documents are presented by the seller to the Chase National Bank in New York, which pays the invoices with funds furnished from the U.S.S.R. for the purpose. Presentation of documents may be either direct or through a local bank. There is no record of refusal to pay an invoice properly drawn up and supported by shipping documents.

Negotiation. In negotiating its purchase contracts, the Amtorg usually follows the custom of other large buyers, and asks for bids from several possible purveyors. Offers are then compared and, other things being equal, the order is placed where prices, terms, and delivery dates are most satisfactory. The course to be followed by an individual bidder is dependent on his own best judgment. Bargaining over price and other details is to be expected. Once the contract is signed, the Amtorg has been scrupulous in adhering to its terms, and has expected the seller to be equally so. Adjustments for cause are always possible.

Patents. Under the patent laws of the Soviet Union, foreign inventions are admitted on the same basis as domestic, conditional on the observance of certain conditions and the payment of scheduled fees. It must be remembered, however, that the only possible user of a patent in the U.S.S.R. is a Soviet manufacturing or other agency; there is therefore only one customer for the sale of a patent. For this reason, patent lawyers in the United States usually advise their clients to negotiate a sale with the Amtorg or a representative of a Soviet agency operating through the Amtorg. Such a sale should be made for a fixed sum, calculated on the basis of reasonable royalties over a term of years. Payment of the agreed-upon sum might be made over a period specified in the contract of sale.

Security. Prospective exporters of articles which may possibly involve matters of military security or military secrets of interest to the national defense, or persons desirous of transmitting abroad information concerning such articles, should communicate with the secretary of state in advance of the proposed transaction in order that he may be in a position to ascertain for the interested person whether military security or military secrets are, in fact, involved therein, pursuant to the provisions of the Espionage Act of 1917 and the regulations of the secretary of state regarding the exportation of articles involving military secrets.

Packing. The Amtorg usually specifies in its contracts that goods shall be packed in accordance with the instructions in the manual "Modern Export Packing," Bureau of Foreign and Domestic Commerce, Washington, D. C.

Arbitration. The Amtorg customarily includes in its purchase contracts a clause providing for settlement of any disputes between buyer and seller by the Foreign Trade Arbitration Commission of the U.S.S.R. Chamber of Commerce in Moscow. If the contract provides that the goods shall be inspected and accepted before shipment, however, many causes for possible dispute will be eliminated. Other means of arbitration exist, and the Amtorg has entered into contracts calling for arbitration of disputes in accordance with the rules of the American Arbitration Association or the laws of the State of New York.

● **Procedure for export sales.** In a typical case of a sale to the Amtorg of a bill of goods for export from the United States, the procedure would be as follows:

The domestic manufacturer or exporter may be approached by the Amtorg, the United States firm may approach the Amtorg, or a representative of a Soviet Import Combine may approach the domestic producer or seller. Negotiations follow, in which the terms of the contract are discussed, and finally agreed upon. In the case of manufacture of the same goods by several firms in the United States, competition between them is utilized by the Amtorg.

Many contracts provide for frequent inspection of goods during their fabrication at the factory. In some cases young Russian engineers are accepted as students by the manufacturer, especially when the product ordered is new and unfamiliar to the Russians. This condition is not so prevalent as formerly, because many Russian engineers have come to the United States during the war, and in this country have familiarized themselves with the latest products and processes of domestic industry. Permission is sometimes given by United States firms for experienced Soviet engineers to assist in the designing and manufacture, according to Russian specifications, of some particular product or complete assembly.

Firms seeking export business often send circulars or salesmen to the Amtorg

(Continued on Page 115)

FAR EASTERN OIL DEVELOPMENT

THE principal concern of the American Overseas Petroleum Company at present is a concession in Central Sumatra held by its subsidiary, the N. V. Nederlandsche Pacific Petroleum Maatschappij. Before the war put an end to all oil enterprises in this part of the world, 4 wells had been completed in the Doeri field. These had all the appearance of opening up a new producing area, but shortly after they were brought in the Japanese took over, so the initial production and subsequent behavior of the wells have remained undetermined.

Wells have been drilled by N. V. Nederlandsche Pacific Petroleum Maatschappij in two fields in this area; namely, Doeri and Soebanga. As soon as conditions will permit, N. V. Nederlandsche Pacific Petroleum Maatschappij expects to re-enter Sumatra with two rigs and will also send a geological mission down to the territory to complete the correlations that had to be abandoned so suddenly some four years ago.

Although the termination of hostilities is still too recent to permit any accurate prediction, the company hopes to get an advance party into the producing area before the end of the year.

It should perhaps be explained here that American Overseas was originally formed to manage foreign exploration and development activities of companies jointly owned by Standard of California and The Texas Company, with the exception of joint interests in Arabia and Bahrein. This organization directs or has directed the exploration and development of properties in Egypt, New Zealand, Australia, and was designed to operate Netherlands East Indies properties after their liberation from Japan.

★ ★ ★

KEEP YOUR
SHUT!
DONT GIVE THE RATS ANY INFORMATION!
WARNING!
WALLS HAVE EARS
BE CAREFUL OF WHAT YOU SAY!
LOOSE TALK
CAUSE THIS
DONT BE A DOPE AND SPREAD INSIDE DOPE
LOOSE TALK
CAN COST LIVES
LOOSE TALK
CAN COST LIVES
LOOSE TALK
CAN COST LIVES
QUIET!
LOOSE TALK
CAN COST LIVES
NOW
IT CAN BE TOLD
The veil of secrecy which, of necessity, has shrouded the operations of war plants, has now been lifted and we can tell you much about the little known facts that have brought high honors to our company and to the oil industry with which we are so proudly identified.

AT THE CLOSE OF HOSTILITIES, only eight war plants* in the entire nation were permitted to fly the United States Navy Bureau of Ordnance Flag and the All-Navy "E" Burgee with six white stars affixed—each star indicative of a renewal of the first "E" award made in World War II. The original "E" award was made in July, 1941.

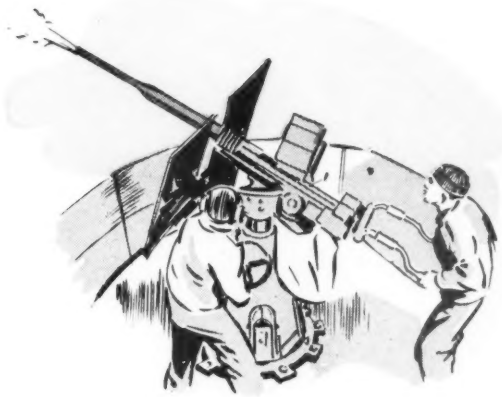
The men and women of Cameron Iron Works, whose outstanding record of Naval ordnance production made it possible for their company to retain membership in this distinguished group of American industrial plants, are justly proud of this signal honor.

On the following pages are listed production figures on each item of Naval ordnance materiel produced in the five Cameron war plants. Along with these huge quantities of war goods, Cameron engineers found time to develop and perfect the new sensational type "QRC" blowout preventer and type "GP" valve while producing unprecedented quantities of oil field equipment.

---

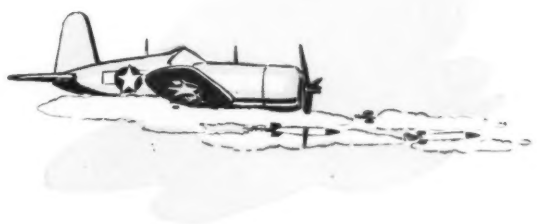
* *Arma Corporation, Brooklyn, N. Y.*
Cameron Iron Works, Inc., Houston, Texas
Ford Instrument Co., Inc., Long Island City, N. Y.
General Motors Corp., Fisher Body Div., Die & Machine Unit, Detroit, Mich.
Keuffel & Esser Co., Hoboken, N. J.
The Midvale Co., Nicetown, Philadelphia, Pa.
Miehle Printing Press & Manufacturing Co., Chicago, Ill.
Northern Ordnance, Inc., Minneapolis, Minn.

ITEM	NUMBER PRODUCED
Type "K" Depth Charge Projectors (Navy's entire requirement)	**14,826**
Arbors for Depth Charge Projectors	**313,050**
Breech Mechanism Covers for Depth Charge Projectors	**15,667**



ITEM	NUMBER PRODUCED
Hydraulic Mounts for 20mm Guns	**2,298**

ITEM	NUMBER PRODUCED
Yokes for 4-Inch Guns	**438**

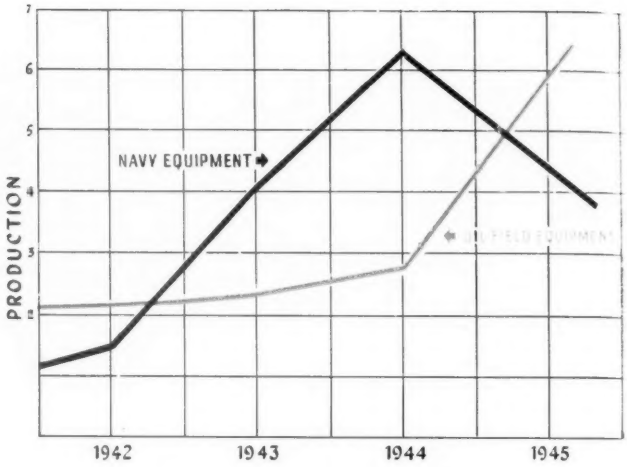


ITEM	NUMBER PRODUCED
Rockets	**(Production figure confidential but 13 million dollar contract is now nearing completion.)**

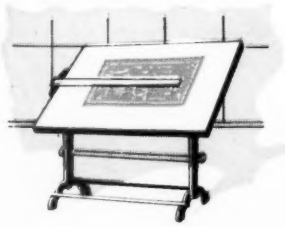
ITEM	NUMBER PRODUCED
Signal Flare Projectors	**2,642**

ITEM	NUMBER PRODUCED
3-Inch Barrels for 50 Calibre Guns	**2,585**

ITEM	NUMBER PRODUCED
Roller-Turner Attachments for War Plant Turret Lathes	2,739

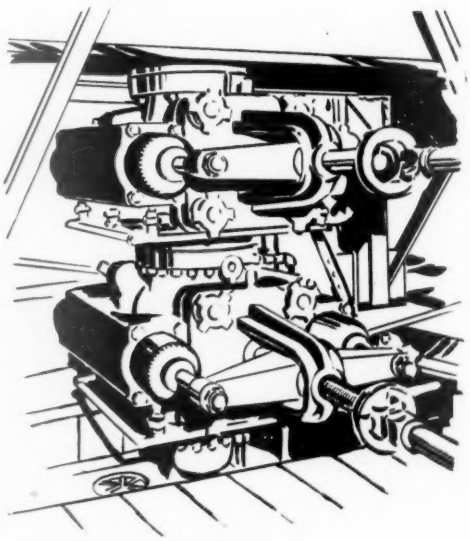


From June, 1941, to June, 1945, Cameron's production of oil field equipment soared to unprecedented heights as PAW requests for new wells increased from year to year. The above graph clearly reflects this increase as well as the rapid and simultaneous rise in the production of naval equipment.



EXPERIMENTAL CONTRACT

Cameron Iron Works enjoys the distinction of being one of the very few independent industrial plants in the country with whom the U. S. Navy, Bureau of Ordnance, maintains an experimental contract.



"WAR BABIES" WITH A PEACETIME FUTURE

The new Cameron Type "QRC" (Quick Ram Change) Pressure Operated Blowout Preventer is superior to all previous Cameron drilling control units. It was conceived, developed and supplied in substantial quantities long before "VE" day, despite extremely heavy demands for naval ordnance materiel. The "GP" (Gate-Plug) Valve, like the "QRC" Blowout Preventer, was in production many months ago, employing an entirely new and more efficient design. Plans are now under way for mass production of the "GP" Valve.

CAMERON IRON WORKS, INC.

711 MILBY ST., HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. • California: Howard Supply Co., Los Angeles
Oklahoma: 310 Thompson Bldg., Tulsa

(Continued from Page 110)

to solicit orders. Many of these firms become impatient at the delay that may ensue while such offers are "referred to Moscow." It must be remembered that the Amtorg is only an agent, acting for principals in Moscow who purchase "according to the Plan;" variations from the Plan often require much discussion and consideration before they can be adopted. In the event that any interest is indicated by the Amtorg in a particular offer of goods, patience and persistence should be exercised by the prospective seller.

Representatives of manufacturing firms in the United States occasionally are invited to Moscow to discuss potential business. Under the Soviet law, permanent foreign salesmen and service men are permitted to reside in the U.S.S.R.; however, they are subject to registration and special taxes. It is possible that wartime restrictions on the issue of entrance visas to such men will be eased after the war, and that they will be allowed to enter the U.S.S.R., reside there, and visit plant executives who are interested in their products or need their services. It may be noted that at the present time no general treaty of friendship, commerce, and navigation, which would serve to protect the rights of American citizens in the Soviet Union, has been concluded between the United States and the U.S.S.R.

● **Payments for exports.** Payment by the Amtorg for an export order is effected by presentation of the invoice to the Chase National Bank.

It may be anticipated, however, that after the war Soviet foreign exchange reserves will not be sufficient, even after the foreign trade of the U.S.S.R. revives, to pay at once for the enormous quantities of goods which the Soviet Union may desire to purchase abroad for rehabilitation, reconstruction, and expansion of its national economy. The United States is probably the primary market where the kinds and quantities of goods most needed by the U.S.S.R. for these purposes during immediate postwar years can best be obtained. Thus it has been suggested that the United States Government create a large fund for long-term credit financing to permit prompt payment for exports to the U.S.S.R. If this suggestion is adopted, payment of the invoice for a sale to the Amtorg probably will involve a procedure different from that previously followed.

Although few American corporations can extend credits to purchasers of export goods for terms longer than 1 or 2 years, it is not impossible that some firms will find it possible, after the war, to quote 5-year terms for large orders with appropriate safeguards to insure the protection of both parties in all cases.

A third possible method by which payment of long-term bills might be arranged is through the establishment of a consortium of banks in the United States to cooperate in making available to the Government of the U.S.S.R., or to the Amtorg, a large credit of the type required. In such case, the domestic seller would present his invoice for payment to the representative of the consortium.

● **Procedure for importation.** The Amtorg, as agent for the Soviet Export Combines, handles all sales of Soviet products to markets in the United States. Usual procedure is for the Amtorg to receive and warehouse all goods, and sell for spot delivery for cash. However, consignment contracts have been entered into with a consignee in the United States who takes delivery and settles for sales made, as agreed upon with the Amtorg. Forward contracts also are made by the Amtorg with large purchasers, sometimes over a period of years, calling for deliveries at United States ports of regular monthly quantities, with warehousing or storage as agreed upon.

Spot or future sales of Soviet products to buyers in the United States also may be negotiated in Moscow by a representative of a domestic firm who would deal directly with the Soviet Export Combine. In such a case the Amtorg merely clears deliveries, collects payments, and generally supervises the execution of the contracts.

Furs imported from the U.S.S.R. are sold either to representatives of United States firms resident in Moscow, or by auction in New York City. This is a wartime procedure. The usual method of sale by semiannual auction in Lenin-

Selections from the

"Most Complete Line of Tongs in the World"

PETOL TOOLS TITAN TOOLS

WRITE FOR CATALOG NO. 50

28 TYPES

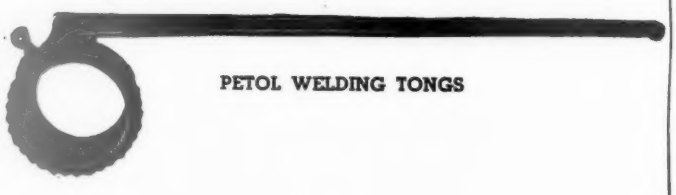
A TYPE FOR EVERY PURPOSE

290 SIZES

A SIZE FOR EVERY REQUIREMENT

PETOL STABBING TONGS

PETOL PIPE TONGS



PETOL WELDING TONGS

TITAN REVERSIBLE CHAIN TONGS

TITAN PIPE TONGS

Gearench Mfg. Company

HOUSTON, TEXAS, U. S. A.

EXPORT: 74 Trinity Place, New York, N. Y.

grad may be resumed when circumstances make it feasible.

In all matters connected with the sale by the Amtorg of Soviet products in the United States, domestic practice is followed in the main, and domestic market standards are observed. It is believed that increased freedom of travel to and in the U.S.S.R. after the war will make it profitable for importers in the United States to become more familiar with the materials and goods produced in the Soviet Union. Importers should be able to increase the quantities of these articles sold on the domestic market. Selection, classification, sorting, seizing, and packing according to United States specifications could be arranged by contract, sales could be made on acceptable samples, or Soviet goods could be manufactured to designs and patterns known to be popular in the United States.

● **Technical-aid contracts.** At the outset of the first Five-Year Plan, the Soviet Union initiated the practice of negotiating contracts with foreign firms for the provisions of technical assistance. Under such a contract, the firm agreed to place at the disposal of a specified Soviet agency, for a named consideration, all of its manufacturing skill and experience, blueprints, drawings, formulas, and engineering data to the extent necessary to enable the Soviet agency to manufacture a certain product or apply a particular process in a factory or mine of the Soviet Union, using native materials and labor. The contract might involve engaging the services of the firm, or of men selected by the firm, to erect plants, install machines, and introduce processes in the U.S.S.R., and otherwise assist Soviet engineers and workers to initiate a new form of manufacture.

Representatives of Soviet agencies and of the Amtorg have already opened negotiations with firms in the United States, looking toward the conclusion of additional contracts for technical aid in the U.S.S.R., to be carried out when circumstances permit. The details of such a contract should be approved by legal counsel, but information on the following points may be useful to firms considering or undertaking contracts of this type with Soviet agencies. Additional information may be obtained from the Bureau of Foreign and Domestic Commerce or from its regional offices.

A contract with a Soviet agency of the type described may become the subject of suit in a Soviet court. Unless the American party is prepared for such adjudication, which requires application of Soviet law or the calling of expert witnesses by a Soviet court to testify as to the law of the State of the United States in which the contract was executed, it would be wise in the contract to confer jurisdiction upon a court of the United States and to provide that the law to be applied shall be the law of a State of the United States. If the added protection of access to an American corporation is desired, the Amtorg may be asked to become a party to the contract.

A specific guaranty of the operation of a machine, the success of a process, or the production of a stated output should not be made unless the contract provides for a thorough operating test, under supervision of technicians from the United States, of the machine or process in the U.S.S.R. Many disputes may be avoided by providing for an operating test in the firm's plant or factory in the United States in the presence of Soviet engineers or of qualified United States engineers, and an acceptance by the Amtorg or the engineers of satisfactory performance.

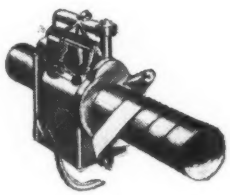
It may be noted that the Amtorg and other Soviet agencies that have signed technical-aid contracts with firms in the United States have earned a reputation for fulfilling these contracts to the letter. Nevertheless, it obviously is desirable that all points where disputes might arise should be covered in the contract and not left to later interpretation.

● **U. S. citizens in U.S.S.R.** In connection with many contracts for technical aid with Soviet agencies, it often happens that engineers and other skilled workers who are citizens of the United States are engaged, through their employers or as individuals, to live and work in the U.S.S.R. for a specific period, usually 1 year, subject to extension by agreement.

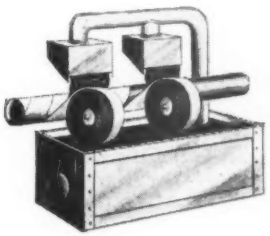
The U.S.S.R. Chamber of Commerce in Moscow published in 1931, in its handbook of Economic Conditions in the U.S.S.R., a "Specimen Contract with Foreign Specialists," which contained a number of provisions to safeguard the interests of both

The economics of cathodic protection

require the use of stable pipe protection plus modern methods of application and electrical inspection

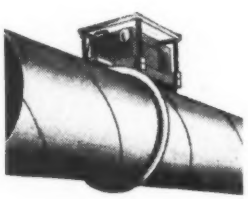


BARRETT Coal-tar Enamels, because of their low moisture absorption under varying conditions of the soils, provide a constant, uniform and long-lasting stable underground insulation.



Mechanically applied by modern methods, these coal-tar enamels assure the proper continuity of the insulation.

Electrical inspection improves the quality of application and the handling of pipe during construction and, together with a pipe protection of stable dielectric strength, makes cathodic protection economical. This combination permits the use of a minimum number of cathodic protection units, spaced the maximum distance, and a minimum investment in the complementary electrical protection. A dependable procedure when designing corrosion-proof pipelines.



FIELD SERVICE: *The Barrett Pipeline Service Department and staff of Field Service men are equipped to provide both technical and on-the-job assistance in the use of Barrett Enamel.*

Barrett COAL-TAR ENAMEL

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

parties to the contract. Attention is called to the following conditions which are of importance to the United States citizen employed in the U.S.S.R.

Transportation. The Soviet employer pays transportation to and from the U.S.S.R., or remiburses the employe if the latter defrays this expense. Expenses should include all reasonable charges for the employe and his family. Baggage usually is admitted free of duty. Traveling expenses in the U.S.S.R. are paid by the employer, except for personal trips not of a business nature.

Quarters. It should be specified that the quarters provided should be satisfactory. Otherwise the employe may suffer from the severe shortage of housing that exists in most communities. The specimen contract phrase "a room (or rooms) with all necessary furniture" is obviously too vague to accept, and a more definite statement should be required. It must be remembered that conditions in the territory devastated by the German armies will be unusually difficult until permanent reconstruction is completed.

Rations. The employe from the United States probably will be placed automatically in the top class of Soviet engineers, and as such will be entitled to ration cards for all basic foodstuffs. In addition, he should have the privilege of purchasing goods at the "Insnab" (Foreigner's Supply) stores, usually better stocked than the State shops; the latter supplement the ration stores. For several years after the war, the shortage of consumption goods and foodstuffs that has prevailed throughout the war may be expected to continue. It is therefore wise to obtain, by contract, the right to import without duty some foodstuffs, clothing, and toilet articles to augment the year's supply of such goods brought in as baggage when entering the U.S.S.R., and to import and use short-wave radios.

Families. In most cases it is considered unwise for wives and children to accompany employes from the United States. The strangeness of language, conditions, and habits present difficulties for women from the United States, and the absence of educational facilities similar to those in their home country is a serious loss for children of school age.

Taxes. The usual individual contract with a foreign technician calls for the payment of income and other taxes "in accordance with the laws of the U.S.S.R." Burdensome taxes can be avoided by stipulating that the levies would apply only to the portion of the salary that is paid in rubles and not to any portion paid in dollars. Labor-union dues, bond subscriptions, and other contributions generally made by workers also should be paid in rubles.

Salaries. For a number of years after the war, retail prices except at ration stores are likely to be high until a greater supply of consumption goods results in an increase of the purchasing power of the ruble. It is therefore wise for a technician (or the firm in the United States that employs him) to require that salaries should be paid in rubles and dollars, and that at least 50 per cent of the total be in the latter currency. These dollars may be deposited periodically in a checking account in a bank in the United States; thus they will be available when desired. The ruble portion of the salary should be sufficient to cover all ordinary living expenses in the U.S.S.R., and equal to the salary received by similar Soviet technicians. Dollars can always be exchanged for rubles at the official rate if additional foreign currency is required. Rubles can be exchanged for dollars only by a special permit that is readily obtainable only if the contract includes a provision to cover this exchange.

Vacations. Foreign technicians will often desire to spend their vacations outside the U.S.S.R. Until rubles are accepted in exchange in foreign countries, the contract should provide that the entire salary for the vacation period be paid in dollars.

Labor laws. Labor laws in the Soviet Union apply equally to Soviet and to foreign workers, as do the social-insurance laws. A foreign technician therefore is eligible for all the benefits of health protection, medical and dental care, day nursery and kindergarten, and other privileges that are available to Soviet workers, and are regarded as part of the regular salary. A foreign worker also is eligible for the premiums, overtime payments, incentive payments, and rewards for savings in manufacturing cost achieved as a result of his suggestions or inventions. He can patent his inventions in the U.S.S.R. Trade-union membership is open to foreigners, as is membership in a consumers' cooperative store. Free or low-priced tickets to operas and concerts, membership in clubs, access to libraries and sport stadiums, and similar benefits usually are provided in connection with work in a Soviet plant or factory, when these facilities are available.

APPENDIX I

Export combines:

Eksportlen* (The all-union combine for the export of flax and hemp, and the products of flax and hemp cultivation). Address: Ulitsa Kalyayeva 5, Moscow.

Exports flax and hemp fibers, yarn, and thread, and linen, including handicraft linen.

Eksportles* (The all-union combine for

APPENDIX III—(Appendix II has been omitted as not pertinent to the oil industry.)

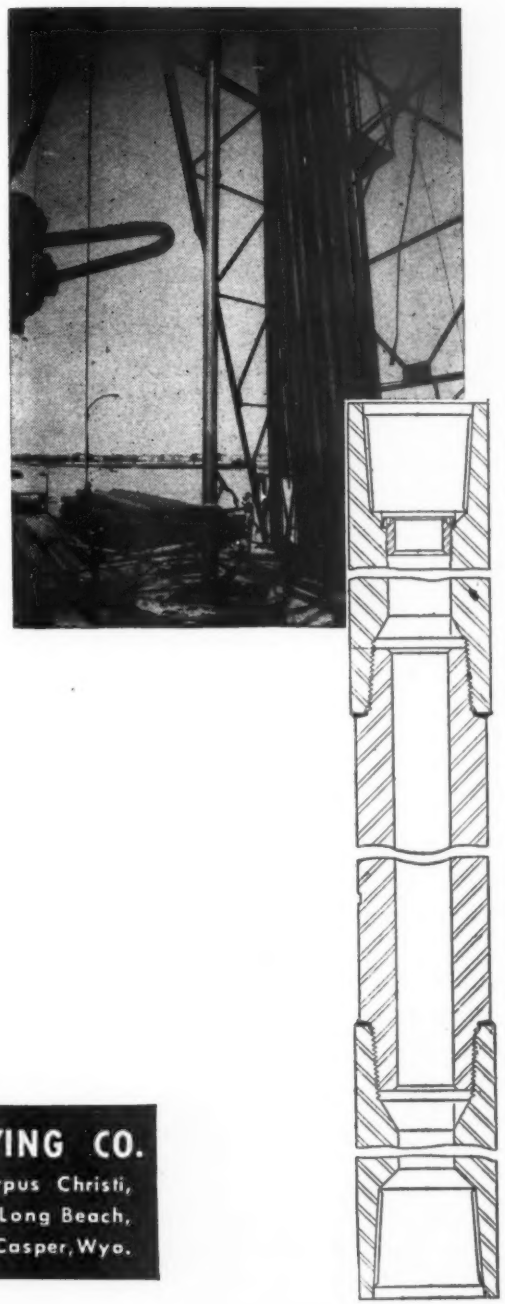
TABLE 1—United States exports to the U.S.S.R., by groups and principal commodities

Commodity and group	Quantity			Value ($1000)		
	1936	1937	1938	1936	1937	1938
Exports, including reexports, total	..	..	..	33,427	42,892	69,691
Animal products and animals, inedible, total	..	..	..	287	19	2
Goat and kid upper leather, 1000 sq. ft.	647	*	..	224	*	..
Vegetable products, inedible, total	..	..	..	54	711	59
Alfalfa seed, 1000 lb.	..	2,300	..	..	689	..
Nonmetallic minerals, total	..	..	..	3,742	6,362	5,844
Gasoline and other petroleum motor fuel, in bulk, 1000 bbl.	546	1,544	1,120	1,300	3,718	2,247
Wheels of artificial abrasives, 1000 lb.	1,801	1,576	1,331	743	766	653
Carbon electrodes for furnace or electrolytic work, 1000 lb.	10,848	12,574	13,435	1,459	1,795	1,873
Other nonmetallic minerals	..	..	..	240	83	1,071
Metals and manufactures, total	..	..	..	5,738	13,748	12,148
Iron and steel plates, 1000 lb.	3,927	31,361	3,431	121	982	110
Steel sheets, black, 1000 lb.	79,541	93,480	91,643	2,560	3,390	3,090
Strip, hoop, band and scroll iron and steel, 1000 lb.	32,711	19,621	22,194	843	887	1,071
Tin plate and taggers' tin, 1000 lb.	17,259	17,674	12,677	811	1,023	775
Boiler tubes, 1000 lb.	3,003	9,626	5,818	436	762	672
Wire and manufactures, 1000 lb.	479	6,904	1,224	57	487	266
Car wheels, tires and axles, 1000 lb.	..	24,497	686	..	984	37
Ferro-alloys	..	..	..	145	3,776	3,173
Aluminum plates, sheets, bars, strips and rods, 1000 lb.	1	8	1,129	4	*	1,120
Refined copper in ingots, bars, or other forms, 1000 lb.	11	4,395	110	1	437	13
Other products of iron and steel and others metals and manufactures	..	..	..	760	1,020	1,821
Machinery and vehicles, total	..	..	..	22,198	20,195	49,909
Industrial electric furnaces, ovens, etc., number	58	39	181	122	153	1,510
Radia apparatus	..	..	..	247	1,324	278
Construction and conveying machinery	..	..	..	325	87	138
Well and refinery machinery	..	..	..	510	3,346	582
Pumping equipment	..	..	..	83	266	142
Metal-working machinery	..	..	..	15,383	6,954	35,080
Lathes, number	251	83	770	1,652	560	5,021
Boring, chucking, thread-cutting, and milling machines, number	393	297	1,134	2,259	1,969	8,605
Drilling machines, number	173	103	308	772	484	1,585
Metal-grinding machines and parts	..	..	..	1,396	1,456	6,792
Sheet and metal-working machinery and parts	..	..	..	1,455	576	3,220
Forging machinery and parts	..	..	..	671	462	1,764
Rolling-mill machinery	..	..	..	2,630	489	3,416
Textile machinery	..	..	..	581	211	67
Brewers' machinery	..	..	..	374	195	*
Ball and roller bearings and parts	..	..	..	296	165	241
Air compressors, number	5	13	96	27	30	899
Automobiles, parts and accessories	..	..	..	725	409	343
Aircraft and parts	..	..	..	269	3,213	5,171
Other machinery and vehicles	..	..	..	3,256	3,842	5,458
Chemicals and related products, total	..	..	..	219	424	847
Sodium compounds, 1000 lb.	347	910	1,576	80	196	345
Miscellaneous domestic articles, including total reexports of foreign merchandise	..	..	..	1,189	1,433	1,152
Scientific and professional instruments	..	..	..	332	463	639

*Less than 500.

Once Again Sperry-Sun Brings the Oil Industry a Tool of Outstanding Usefulness

The S-S *Non-Magnetic* DRILL COLLAR



Sperry-Sun, for years a leader in the field of well surveying instruments and services, again scores with its S-S Non-Magnetic Drill Collar for use with Directional Magnetic Single Shot Instruments.

Heretofore it has been necessary to operate instruments having magnetic compasses, in open holes or through specially designed drill bits, or through wire line core barrels.

A great saving of rig time, more accurate records and less hazardous operation are effected by employing the S-S Drill Collar. It is inserted immediately above the drill bit, and is made with proper seating arrangement to center the directional single shot instrument.

Any operator will recognize its particular advantages when used in directional controlled drilling. The statement that it is made of "K" Monel metal is sufficient evidence of its strength and resistance to wear. Made in standard sizes.

Available on a rental or outright sales basis. Write for further information.

SPERRY-SUN WELL SURVEYING CO.

Offices: Philadelphia, Pa.; Houston, Corpus Christi, Marshall, Odessa, Texas; Lafayette, La.; Long Beach, Bakersfield, Calif.; Oklahoma City, Okla.; Casper, Wyo.

TABLE 2—United States imports from the U.S.S.R., by groups and principal commodities

Commodity and group	Quantity			Value ($1000)		
	1936	1937	1938	1936	1937	1938
Imports for consumption, total	..	..	..	21,383	27,239	23,532
Animal products and animals, edible, total	..	..	..	1,931	2,176	1,328
Sausage casings, 1000 lb.	607	200	199	979	550	397
Butter, 1000 lb.	560	2,138	2	102	355	*
Caviar and other fish roe, 1000 lb.	330	227	110	323	316	181
Crab meat, sauce, and paste, 1000 lb.	1,540	2,850	1,817	316	698	522
Other animal products, edible, mainly fresh fish	..	..	..	211	257	228
Animal products and animals, inedible, total	..	..	..	8,275	12,997	13,187
Goat and kid skins, 1000 pieces	1,366	340	70	661	189	30
Undressed furs	..	..	..	6,432	11,597	12,127
Ermine, thousands	148	253	226	151	471	313
Fox, other than silver or black, thousands	87	142	198	954	1,526	1,566
Lamb, kid, sheep, and goat skin furs, thousands	412	695	976	3,317	6,227	6,705
Marmot, thousands	422	452	343	457	790	533
Squirrel, thousands	806	1,122	2,045	354	519	881
Dressed furs	..	..	..	483	101	258
Manufacturers of fur	..	..	..	557	402	645
Bristles, 1000 lb.	29	164	57	127	692	99
Other inedibles animal products	..	..	..	15	16	28
Vegetable products, inedible, total	..	..	..	355	635	779
Tragacanth gum, 1000 lb.	302	836	359	38	217	56
Licorice root, 1000 lb.	10,507	16,036	15,379	257	328	289
Cigarette leaf, unstemmed, 1000 lb.	*	2	521	*	2	287
Other inedible vegetable products	..	..	..	60	88	147
Textile fibers and manufactures, total	..	..	..	2,322	1,854	1,566
Cotton, raw, 1000 lb.	..	2,502	2,249	..	178	73
Cotton linters, 1000 lb.	7,043	2,742	6,523	233	133	130
Unmanufactured flax, including tow, tons	2,141	1,254	25	756	366	3
Flax fabrics, 1000 lb.	2,076	1,619	2,423	798	704	796
Household articles of flax, hemp, and ramie	..	..	..	164	139	211
Other textile fibers (mainly animal hair) and other textile manufactures	..	..	..	371	334	353
Wood and paper, total	..	..	..	1,334	1,939	511
Sawed boards and lumber of spruce, 1000 ft.	37,820	36,090	..	899	983	..
Rags for paper stock, 1000 lb.	8,184	10,924	6,716	398	597	394
Wastes for paper making, 1000 lb.	560	5,618	1,676	19	347	103
Other wood and paper	..	..	..	18	12	14
Nonmetallic minerals, total	..	..	..	2,865	1,643	1,460
Anthracite, 1000 tons	403	238	179	2,471	1,145	1,125
Asbestos, unmanufactured, tons	5,734	9,118	4,701	307	458	261
Other nonmetallic minerals (mainly magnesite)	..	..	..	87	40	74
Metals and manufactures, except machinery and vehicles	..	..	..	3,360	4,913	3,639
Manganese ore, manganese content, 1000 lb.	315,997	418,288	180,708	2,716	3,960	2,662
Platinum ingots, bars, etc., oz. troy	4,500	14,996	31,431	172	695	964
Iridium, oz. troy	250	2,193	..	35	190	..
Pig iron, tons (2240 lb.)	24,556	4,581	..	251	41	..
Other metals and manufactures	..	..	..	186	21	13
Chemicals and related products, total	..	..	..	581	838	752
Naphthalene solidifying at 79°F., 1000 lb.	5,145	7,091	7,251	98	146	108
Glycerin, crude, 1000 lb.	2,018	1,635	4,758	222	255	374
Ammonium sulphate, tons (2240 lb.)	9,033	4,400	..	189	96	..
Chloride, crude (muriate of potash), tons	..	9,547	4,626	..	303	147
Other chemicals and related products	..	..	..	72	134	23
All other articles	..	..	..	228	165	310

*Less than 500.

the export of timber and timber products). Address: Ploshchad Revolyutsii 1/3, Moscow.

Exports sawn timber, round and trimmed wood, hard and valuable wood, and veneer.

Raznoeksport* (The all-union combine for the export of miscellaneous articles). Address: Ulitsa Kalyayeva 5, Moscow.

Exports casings, leather, wastes, and miscellaneous raw materials, minerals, silicates, rugs, tennis strings, leather haberdashery, medicinal and technical herbs, licorice, chemicals, patent medicines, tobacco, tobacco products, and cotton waste and linters.

Soyuznefteksport* (The all-union combine for the export of petroleum products). Address: Ulitsa Sushchevskaya 21, Moscow.

Exports petroleum and petroleum products.

Soyuzpromeksport* (The all-union combine for the export of industrial goods). Address: Ulitsa Kuibysheva 21, Moscow.

Exports textiles, industrial chemicals, metals, fats, potassium and fertilizers, coal, apatite and its concentrates, iron and manganese ores, asbestos, magnesite, and platinum.

Soyuzpushnina* (The all-union combine for the export of furs and skins). Address: Mezdunarodny Prospekt 90, Moscow.

Exports furs and skins (raw, dressed, and dyed), and live animals.

Tekhnoeksport* (The all-union combine for the export of technical products). Address: Ulitsa Kuibysheva 20, Moscow.

Exports agricultural machinery and implements, sewing machines, bicycles, metals and metal articles, machine tools, automobiles, tractors, and parts thereof.

Import combines:

Mashinoimport* (The all-union combine for the import of equipment, electrical goods, and hauling machinery). Address: Ulitsa Kirova 47, Moscow.

Imports heavy machinery, mining, metallurgical and transport equipment, ships, diesel engines, and power equipment.

Raznoimport* (The all-union combine for the import of agricultural, consumption, and chemical goods). Address: Ulitsa Kuibysheva 21, Moscow.

Imports consumers' goods and miscellaneous articles.

Stankoimport* (The all-union combine for the import of machine tools and instruments). Address: Proezd Khudozhestvennogo Teatra 2, Moscow.

Imports turning machines, milling machines, grinders, automatic and turret lathes, drilling and boring machines, and instruments.

Tekhnopromimport* (The all-union combine for the import of technical goods). Address: Proezd Khudozhestvennogo Teatra 2, Moscow.

Imports machinery for the chemical, food, and light industries; road machinery, precision instruments and apparatus, laboratory equipment, ball and roller bearings, automobiles, tractors, and parts thereof.

Engineering Section of the Foreign Trade Commissariat of the U.S.S.R., abbreviated to Engineering Section of the NKVT, Ulitsa Kuibysheva 23, Moscow. Has charge of the importation of articles of (military) equipment.

Export-import combines:

Eksportkhleb* (The all-union combine for the export and import of grain, forage, and foodstuffs). Address: Kalyaevskaya Ulitsa 5, Moscow.

Exports grains, oil seed cultures, food products, and general agricultural products; fish, fruits, and canned goods.

Imports rice, meats, and other agricultural products.

Soyuzkino* (The all-union combine for the export and import of motion picture films, photo-chemicals, and motion-picture equipment). Address: Chistnoprudny Boulevard 19a, Moscow.

Note: This combine is not under the supervision of the People's Commissariat for Foreign Trade, but is subordinate to the Chief Administration of the Motion Picture and Photo Industry of the U.S.S.R.

Mezhdunarodnaya Kniga-Antikvariat* (The all-union combine for the import and export of lithographic products, office supplies, and antiques). Address: Kuznetski Most 18, Moscow.

Exports new and old publications, printed music, office supplies, school accessories, and antiques.

Imports books, periodicals, office supplies, typewriters, accounting machines, handicraft articles, and precious stones.

Accepts foreign advertisements for insertion in Soviet periodicals.

Promsyrieimport* (The all-union combine for the import of cotton, jute, other textile raw materials and chemicals, nonferrous metals, rubber quoted on the exchanges; and for the export of cotton). Address: Ulitsa Pushkina 23/8, Moscow.

Imports nonferrous metals, fibers, rubber, and cotton.

Exports cotton, chemicals, dyestuffs, essential oils, medicaments.

Vostokintorg* (The all-union combine for trade with Afghanistan). Address: Kuznetski Most 22, Moscow.

Sovmongtuvtorg* (The all-union combine for trade with Mongolia and Tana Tuva). Address: Kalyaevskaya Ulitsa 5, Moscow.

Sovsintorg* (The all-union combine for trade with Sinkiang). Address: Ulitsa Kuibysheva 6, Moscow.

Soyuzfoto* (The all-union trust for the publishing of photographs and photo-illustrations). Address: Ulitsa 25 Oktyabrya 4, Moscow.

Exports and imports photographs and photo-illustrations.

Note: This organization is an independent trust, and not under the supervision of the People's Commissariat for Foreign Trade.

Soviranturktorg. (The all-union combine for trade with Iran and Turkey). Address: Ulitsa Kuibysheva 23, Moscow.

Transport combines:

Lenvneshtrans. (The Leningrad Transport Agency for handling foreign cargoes and goods). Address: Mezhevoi Kanal 5, Leningrad.

Sovfrakht* (The all-union combine for the handling of foreign ships). Address: Ulitsa 25 Oktyabrya 5, Moscow.

Yuzhvneshtrans. (The transport agency for the handling of foreign cargoes and goods in the south of the U.S.S.R.). Address: Ulitsa Lenina 8, Odessa.

*Organizations marked by an asterisk (*) are permitted to conclude foreign trade transactions and to negotiate bills of exchange.

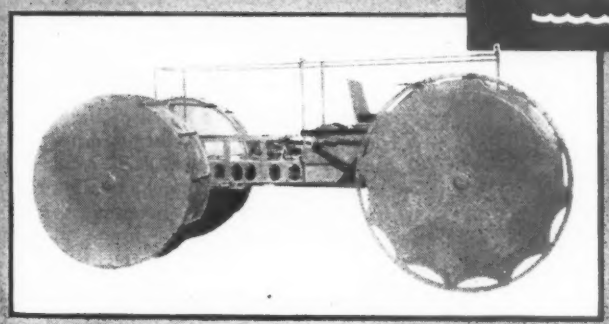
★ ★ ★

Above: Water crossing is easily negotiated. Since power is applied through front wheels, the rear wheels serve as efficient twin rudders.

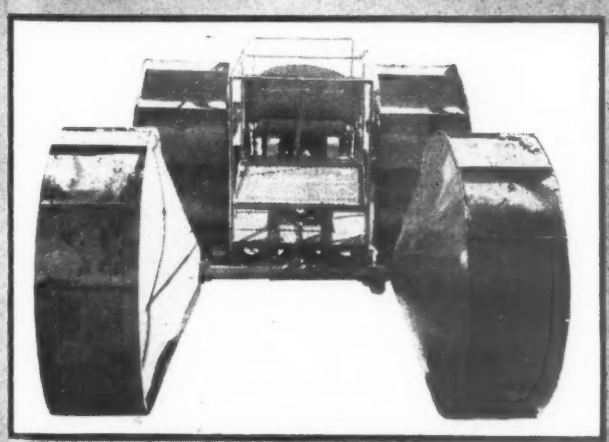
Below: Side view showing the 7' fluted, drum-type front driving wheels and the 6' rear wheels.

DRY LAND
SOFT MARSH
OPEN WATER

They're all the same to the KELPSCH FLOATING MARSH BUGGY



Below: Rear view showing platform and winch built in behind driver's seat.



Here's a marsh buggy that really meets the demand for a vehicle that will "go anywhere". Rugged, dependable, low in first cost and economical to operate, it makes all kinds of marsh land easily accessible and can cross open water without a pause. These buggies are proving their value to nine major companies (names on request), standing up under hard service in this country, and in Central and South America.

Specifications:

- All-steel construction.
- Overall length, 20'-0"; Width, 10'-6".
- Weight, approximately 6000 pounds.
- Powered by a new Ford V-8, 95 hp. motor.
- Speed, land—7-8 mph.; water—5 mph.
- Front-wheel drive for greater manenuverability.
- Oversize radiator, prevents overheating in toughest going.
- Winch and 300 feet of ⅜" cable included as standard equipment.

The Kelpsch Floating Marsh Buggy can be handled completely assembled on a self-loading trailer for quick, easy moving.

For complete information, write:

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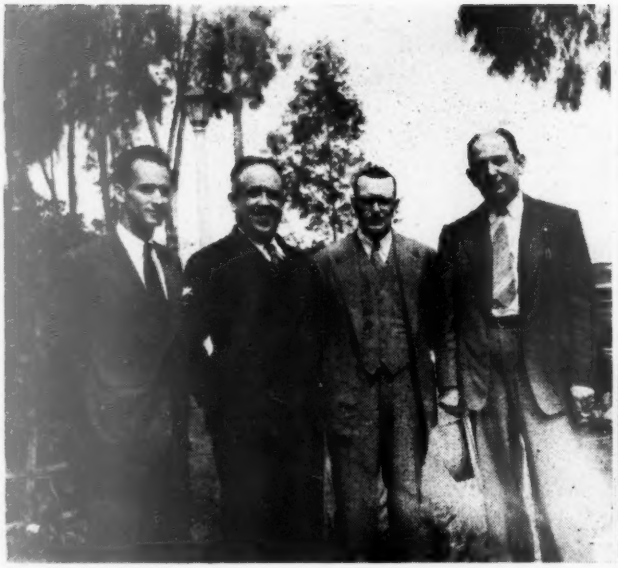
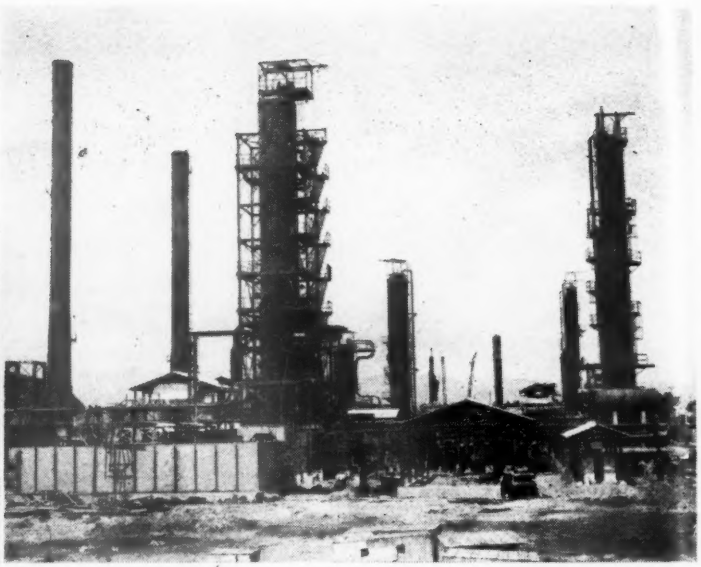




Pemex officials, left to right: Ing. Vincente Pedrero, Cleveland, Ohio, representative of Petroleos Mexicanos; Ing. Jose Colomo, of the general subdirector's office; Ing. A. M. Amor, chief of Department of New Projects; Sr. Federico Aznar, superintendent of Atzcapotzalco Refinery. New crude plant unit at right.

ATZCAPOTZALCO REFINERY ADDITIONS AND NEW PIPE LINE TO POSA RICA OIL FIELD

REFINERY

By **WILLIAM J. DAVIS**

EXCLUSIVE

MEXICO'S Petroleos Mexicanos, otherwise known as Pemex, is making rapid strides in spite of recent war time restrictions toward modernizing its present operating equipment. An outstanding example is the new and modern addition to the old Atzcapotzalco Refinery, which was first built in 1932.

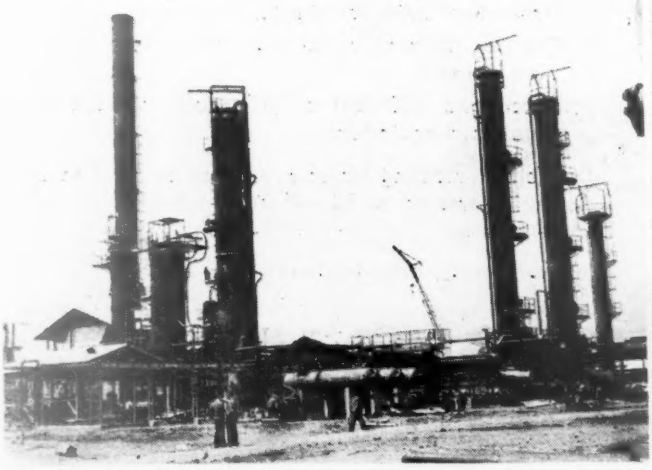
The new additions were begun during the last quarter of 1944 at an estimated cost of 56 million pesos. Pemex officials state that the project is 65 per cent complete at the present time and they expect the plant to be processing Posa Rica crude by the first of next year. When completed, Atzcapotzalco will produce 100-octane gasoline, motor grade gasoline, kerosine, stove oil, tractor fuel, diesel fuel, fuel oil, butane, propane, and other liquefied petroleum gases.

Atzcapotzalco, whose Indian name means "the place with ants," is located within the city limits of Mexico City, about three miles northwest of the heart of town in one of the large industrial sections.

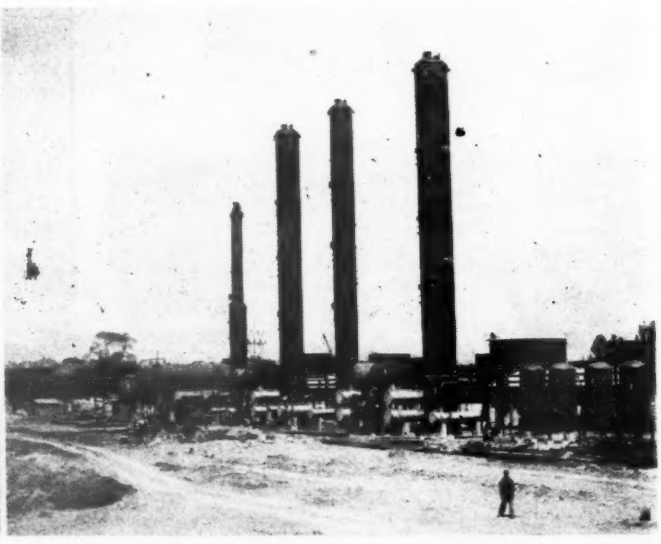
One of the first problems encountered when it was decided to increase the old plant from 20,000 bbl. per day to 40,000 bbl. per day was the matter of firm foundations for heavy towers and machinery, all of which were heavier than the original installation.

Mexico City, along with the location of the plant, is built on a dried lake bed

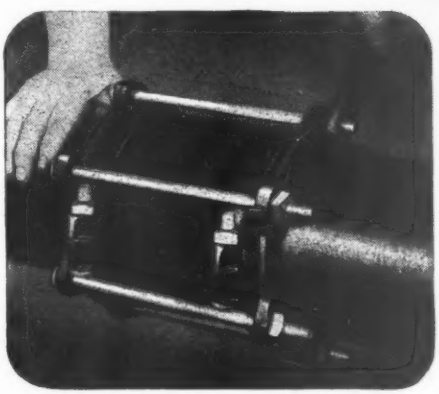
New Atzcapotzalco cracking unit.



Gasoline and liquefied petroleum gas unit.



FOR THREAD LEAKS AT FITTINGS



FOR EVERY TYPE OF COLLAR LEAK

SKINNER-SEAL COLLAR LEAK CLAMP, with its sealed *gasket* and massive construction, stops every type of collar leak.

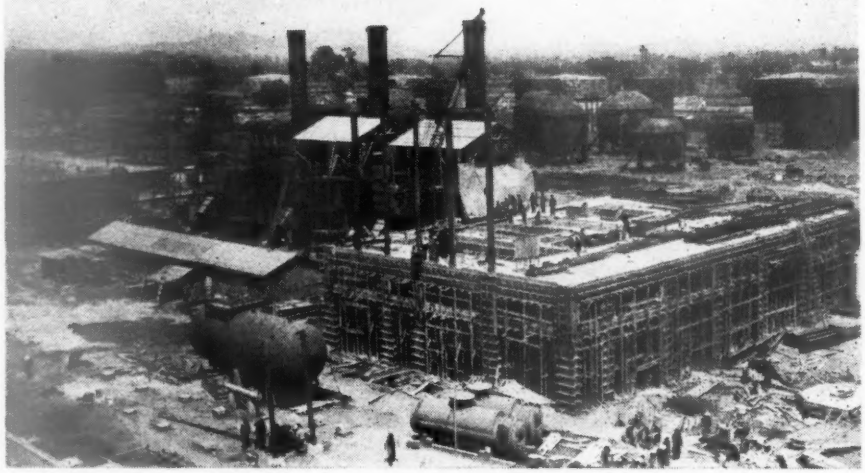
SKINNER-SEAL PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into a fitting. In universal use for nearly half a century. A permanent repair, it saves the cost of tearing out and renewing leaky fittings — and often prevents shutdowns.

Under present disturbed delivery situation — due to factors beyond our control — please place orders as far in advance as possible.

M. B. SKINNER COMPANY, SOUTH BEND 21, IND., U. S. A.

PIPE JOINT CLAMP
COLLAR LEAK CLAMP

SKINNER-SEAL



Top—Another view of gasoline and liquefied gas section, with old plant in background. Center—Power plant turbine room and boiler section. Bottom—Power plant turbine room, with boiler section in background.

hundreds of years old. The resulting deposit of silt of various thicknesses is of very low bearing capacity. As a result, several of Mexico City's famous buildings have settled visibly because this factor was not taken into consideration in the original construction.

In 1944 Pemex engineers began tests to determine at what depth foundation material of a suitable bearing capacity could be found. An 8-in. test hole was drilled on location, which yielded a 4-in. core for examination. At approximately 49 ft. the silt changed to confined sand. Four other test holes drilled on the property confirmed this finding. A number of test pilings were driven and loaded to 60 tons after which observations were made over a period of time to note rate of settling.

The findings from these tests led to the decision to use concrete piling for all heavy structures in the plant. The estimated number of concrete piles for the entire plant is 2400.

General layout is in the form of a rectangle covering 185 acres including the pressure tank farm. This rectangle will enclose the seven distinct units comprising the plant. They are the crude unit, the cracking unit, the power plant and cooling tower, the alkylation unit, the gasoline unit, the manifold pit, and the pressure storage tanks. A road divides the area down the middle of the longer axis with the first four units named on the west side of the road and the last three on the east side of the road. This places the large manifold pit conveniently near the center of the plant.

The power plant consists of three boilers designed to deliver 100,000 lb. of steam per hour at 350 lb. per sq. in. to two steam turbines driving two 5000-kw. generators. Water-cooled condensers handle the exhaust steam from the turbines and some of the low pressure steam is diverted for plant processing purposes.

Tankage at Atzapotzalco was originally built for 395,000 bbl. in 1932. This has been increased to 1,250,000 bbl. under the present project with 80,000 bbl. as pressure storage.

The entire project is being handled by Arthur G. McKee Company, Cleveland, Ohio, acting as general contractors with Phillips Petroleum Company providing supervision on the job.

Pemex expects to employ from 600 to 650 Mexican workers at the plant when all units are in operation.

PIPE LINE

THE pipe line from Tampico, Mexico, to Atzcapotzalco Refinery is being enlarged to take care of increased capacity of the plant. The 12-in. and 10-in. welded carrier, completed in 1931, extends from the Posa Rica fields in Tampico to the enlarged refinery in Mexico City. Additions to the plant, Mexico's most modern, will be finished within a few months, as discussed above.

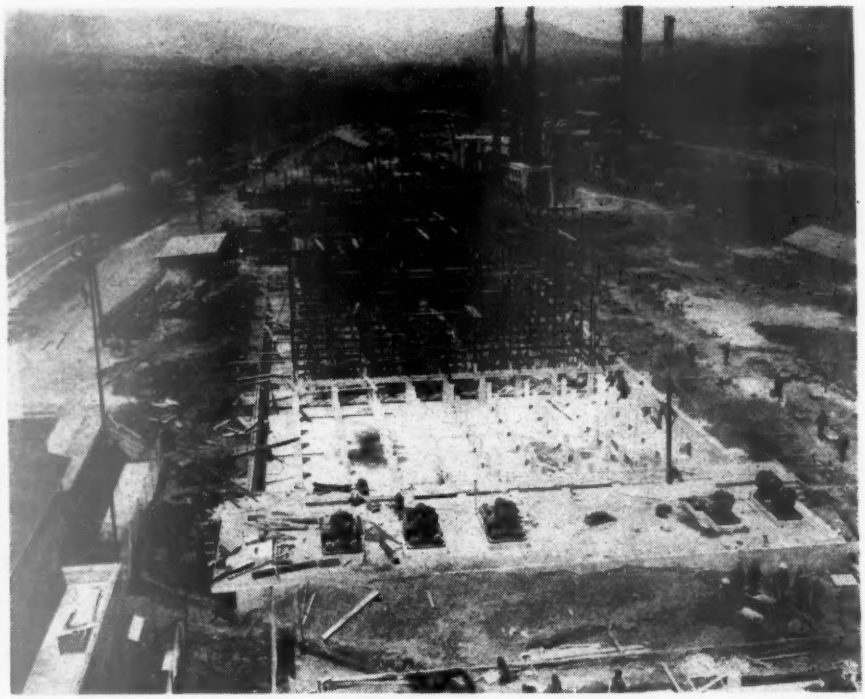
The object of the present construction project, which began in 1942, is to increase the original capacity of the line from 20,000 bbl. per day to 40,000 bbl.

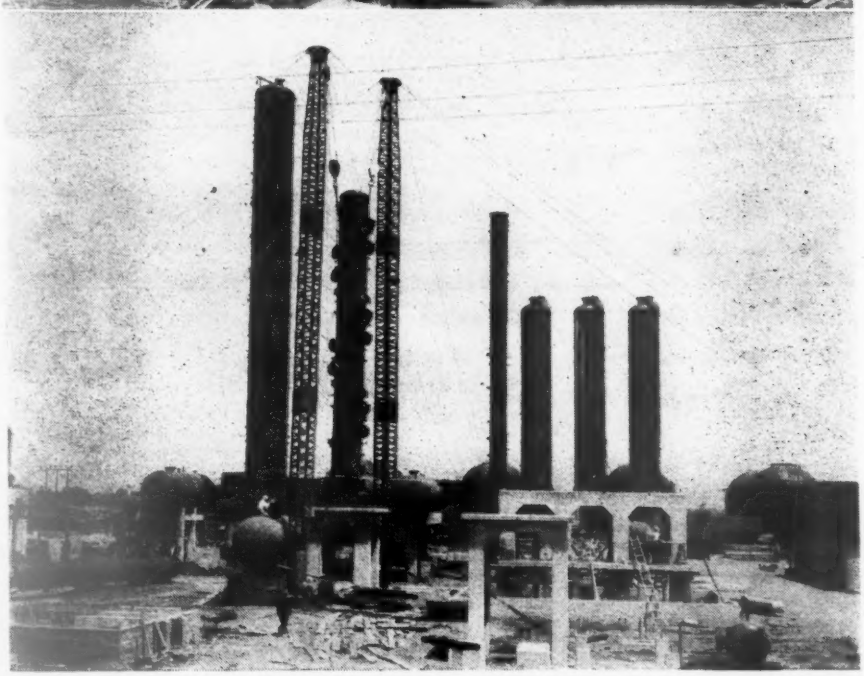
For the Best in Pipe Line Construction

OKLAHOMA CONTRACTING CO.

DALLAS, TEXAS

South America: Caracas, Venezuela, Apartado 1085





Top—Cooling tower and catch basin. Center—Pressure storage tank section, with old tank farm in background. Bottom—Alkylation unit. Erection of tower in acid section.

per day, the latter being the new capacity of the Atzcapotzalco Refinery. It is estimated that the cost of construction will amount to 4,500,000 pesos.

The line as originally constructed consisted of 15 miles of 12-in. welded pipe starting at the Posa Rica field and reducing to 10-in. welded pipe for the remaining 134 miles, giving a total length of 149 miles.

The first 68 miles of the line snaked its way up the rugged Sierra Madre Oriental Mountains from sea level to 7650 ft. at which point the grade fell off to approximately 7000 ft. at Atzcapotzalco.

Nine pump stations located, in one instance, as close as three miles apart force the oil over the high mountains. Each pump station was equipped with two reciprocating pumps electrically driven with a third unit for stand-by.

A re-survey of the line indicated that the desired capacity to meet the demands of Atzcapotzalco could be obtained by using the line as it was originally constructed but substituting centrifugal pumps along with other minor changes.

The unit selected to do the work was a three-stage centrifugal pump direct-connected to a 400-hp. three-phase, 50-cycle, 3000-volt, 2950-r.p.m. induction motor. This unit is rated to deliver 1460 gal. per min. at 780 lb. per sq. in. differential in pressure across any two pumps in the station.

The line is to carry crude plus light ends, and will be operated as a closed system to cut down evaporation losses.

Each station will have a 5000-bbl. rundown tank for emergency purposes only. This tank is sized to empty the line from the next higher pump station in the system should a break occur. It can also be used to "equalize" the line during operations should some other factor disturb the regular flow of crude.

A 1000-bbl. slop tank at each station collects waste from pumps, pits, and traps, settles out BS&W, and is piped to deliver bottoms to the burning pit and tops to the 5000-bbl. rundown tank.

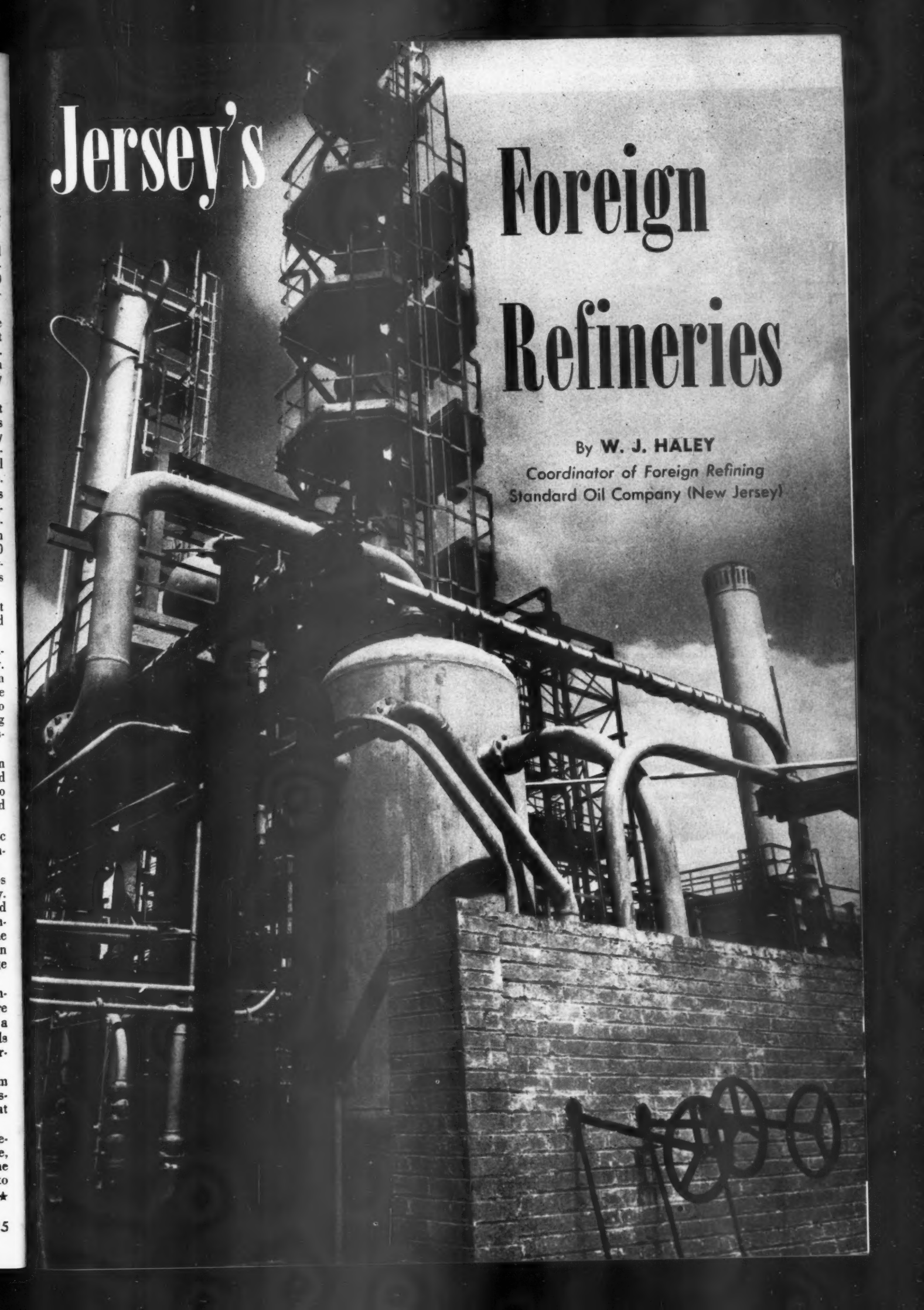
A small auxiliary pump and electric motor deliver oil from the 5000-bbl. rundown tank to suction side of main line.

The three centrifugal station pumps are manifolded for series operation only. A light and sound alarm system operated by line pressure is installed to the incoming suction and outgoing discharge of the station. The discharge alarm shuts down all pumps automatically when discharge pressure drops abnormally low.

Control of the flow of crude is maintained by a fixed differential of pressure between suction and discharge for a given rate of flow. A pilot valve controls the speed of the pumps from this differential.

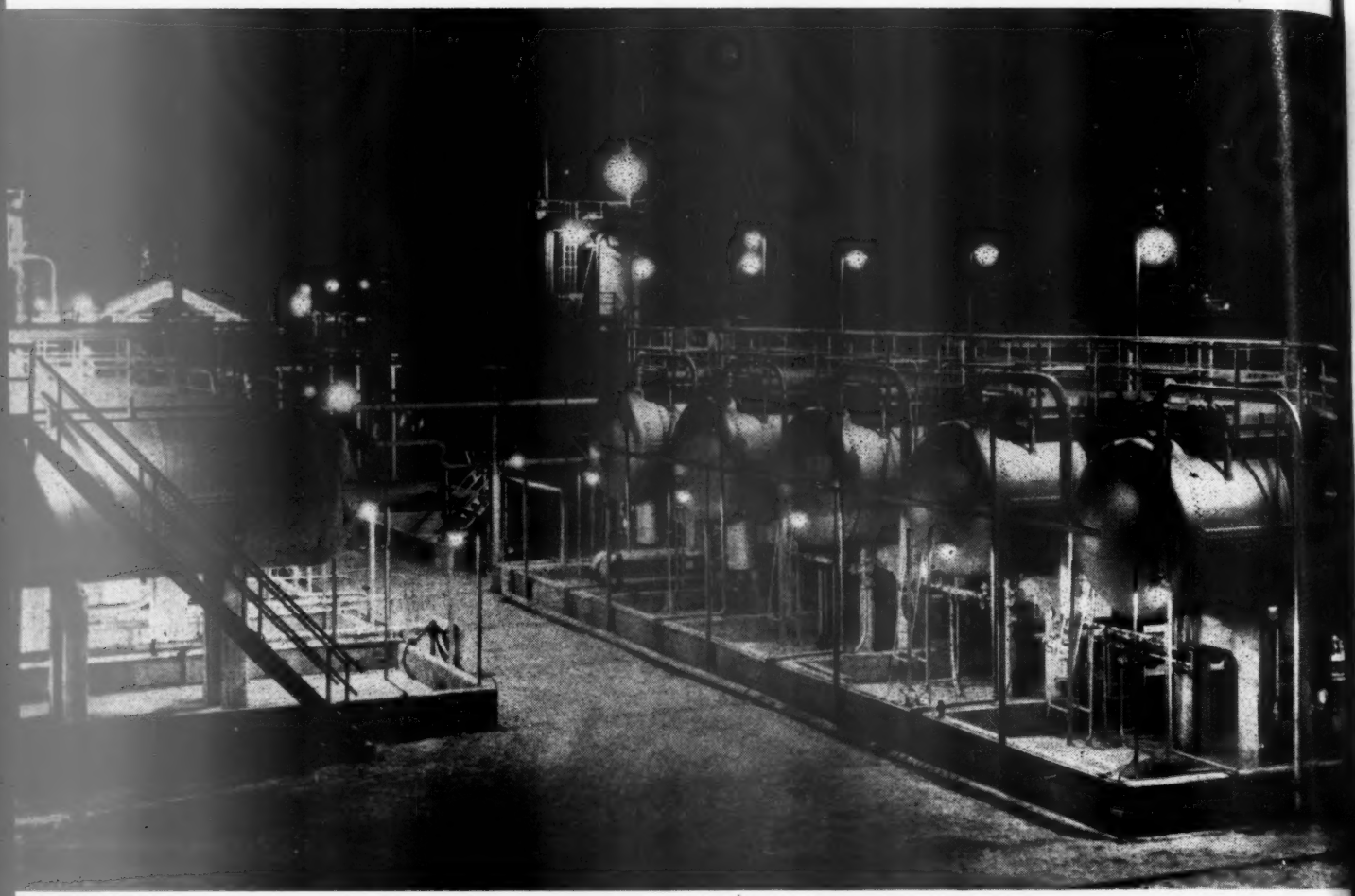
A two-wire telephone system from Posa Rica to Atzcapotzalco aids in dispatching orders and locating trouble at all stations.

At present, pump station improvements are about 60 per cent complete, which brings it to approximately the stage of construction as the additions to Atzcapotzalco Refinery. ★ ★ ★



Jersey's Foreign Refineries

By **W. J. HALEY**
Coordinator of Foreign Refining
Standard Oil Company (New Jersey)



Continuous naphtha treating plant at Port Jerome Refinery, Rouen, France. Photo taken before the war.

WITH the end of the war, Standard Oil Company (New Jersey) began to collect data on refineries operated by its foreign affiliates. Information is still incomplete on the extent of damage to plants in war areas; therefore, it is difficult to determine to what extent foreign refining operations will need rehabilitation, but it is possible to review the situation as it is seen at the present time.

EXCLUSIVE

Affiliates of Jersey Standard operate refineries in Europe, South America, and the West and East Indies. From the standpoint of war damage, the European and East Indian refineries are most important because, of course, plants in the Western Hemisphere were far removed from the scene of actual fighting. An exception was the Aruba refinery, the crude oil supply for which was endangered by submarines. The refinery itself was also shelled by a submarine, but with no damage.

For ease in presentation, refineries discussed will be listed according to the countries in which they are situated.

England

The Fawley Refinery near Southampton was operated by the Agwi Petroleum Corporation, Ltd. With a capacity of 12,000 bbl. per day, Fawley was a complete refinery, manufacturing all products with the exception of lubricating oils. The tanker shortage made it advisable to import finished products into England during the war, rather than to bring in crude oil and refine it there. This, together with the fact that Fawley was in an exposed position from a military and supply standpoint, resulted in a shutdown. Fawley is expected to resume operations now that the war is ended. This should not present a very difficult problem because although the refinery was bombed by the Nazis, it was not severely damaged. It is expected that the Fawley plant will operate much the same as it did before the war.

Extent of war damage to Jersey Standard's refineries throughout the world and ability to produce revealed.

France

Standard Francaise des Petroles operated the Port Jerome refinery situated on the lower Seine between Rouen and Le Havre. Port Jerome was a complete refinery with cracking facilities. It manufactured all products including lubricants and asphalt from Venezuelan, Colombian and Iraq crude. This refinery was badly damaged during the war. Early in 1940, Port Jerome was burned by Standard employes on the order of the French government. It was also bombed by the Germans, and when they later occupied the area they dismantled a substantial amount of the remaining equipment, removing it to Germany and elsewhere. The refinery is being partially rehabilitated at present with special emphasis on gasoline, kerosine, lube oil, and asphalt output.

Belgium

Compagnie Industrielle "Atlas" S.A., operated a topping plant at Antwerp. Light Cumarebo crude was the source of distillate products, the most important being naphtha. There are few finishing facilities at Antwerp, which had a capacity of 1500-2000 bbl. per day. This refinery was not damaged during the war, and although it is believed to be operating at present, there is no detailed information yet available.

Germany

Ebano Refinery near Hamburg, Germany, was operated by the Ebano Asphalt-Werke A.G. primarily for the manufacture of asphalt. Ebano had a capacity of 9000 bbl. per day of heavy Venezuelan crude, but had no finishing facilities for the distillate produced. The refinery was badly damaged during the war, but meager information to date indicates that it is operating at a reduced throughput on locally produced crude.

Norway

The Namco Refinery at Vallo, with a capacity of 1000-1500 bbl. per day, was operated by the A/S Norsk-Amerikansk Mineraloljecompagni. Before the war, this refinery was primarily a source of lubricants and asphalt from Colombian and Peruvian crudes. It was very badly damaged during the war and would need almost complete rebuilding before a normal scale of operation could again be achieved.

Roumania

Romano-Americana operated a refinery of 20,000 bbl. per day capacity at Teleajen, near Ploesti. The refinery produced from indigenous crude all products including lubricants and asphalt. Equipment at Teleajen was conventional and included thermal cracking facilities. Although almost completely destroyed in the war, Teleajen is reported to be operating at a limited throughput.

PHOTOGRAPHS BY STANDARD OIL COMPANY (NEW JERSEY)

Trieste

The Trieste refinery of Standard-Societa Italo Americana Pel Petrolo operated on Colombian and Venezuelan crudes with a capacity of 2500 bbl. per day. This refinery produced a full line of products but had no cracking equipment. Trieste was completely put out of commission in the course of the war and there is little or no information available concerning its present status.

Italy

The Fornovo Refinery near Parma was operated by Societa Petrolifera Italiana. The capacity of Fornovo was 1000 bbl. per day of indigenous crude, which is of very high quality, running about 50-deg. API gravity. Facilities consisted of topping units only. This refinery was completely demolished during the war.

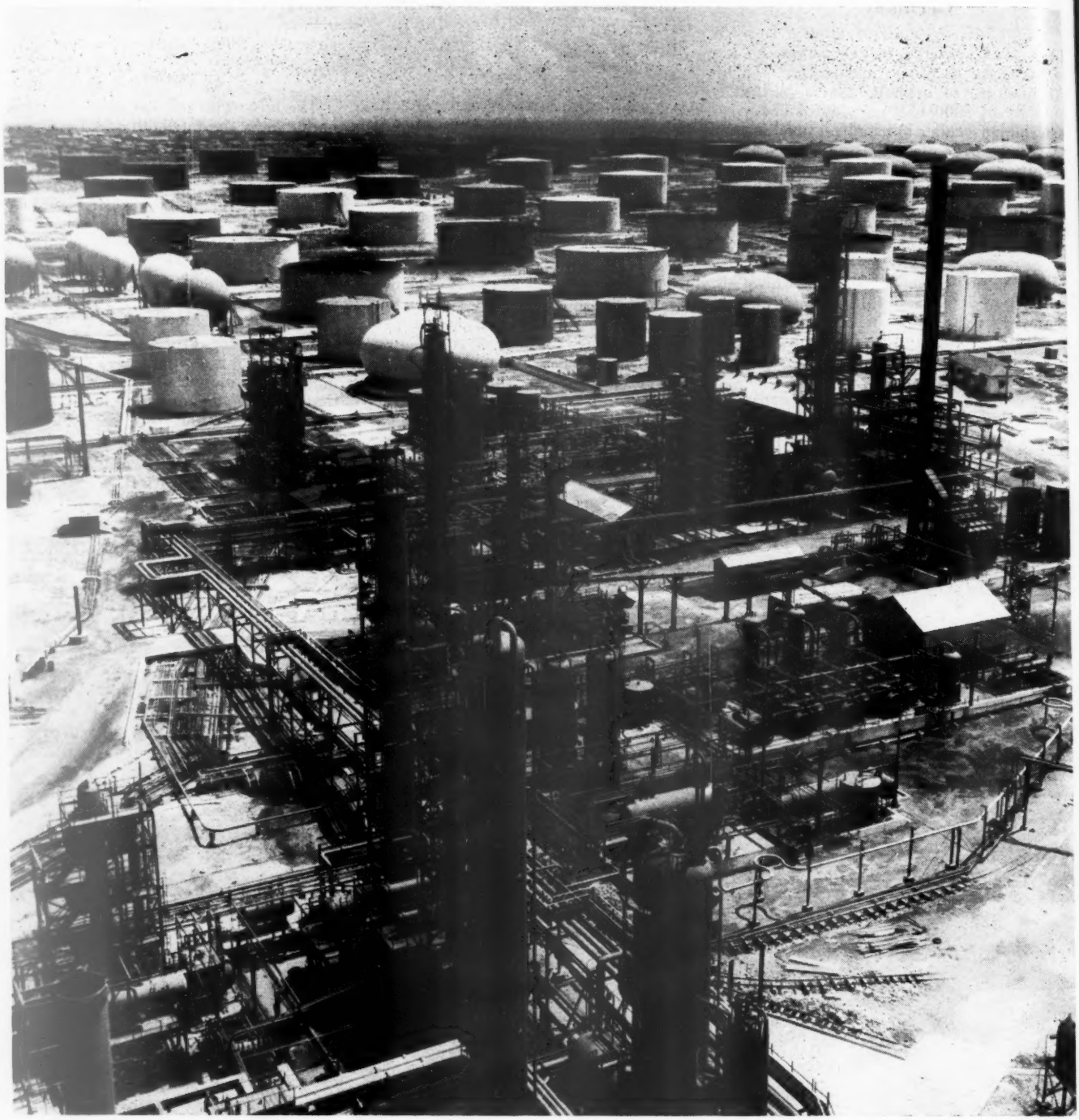
Aruba

The largest oil refinery in the world is operated by the Lago Oil and Transport Company, Ltd., on the small Dutch island of Aruba off the north coast of South America. Aruba had a crude capacity of 300,000 bbl. per day just prior to the war, but during the war it ran as high as 350,000 bbl. for a single day's throughput. On March 15, 1945, the Aruba refinery celebrated the processing of its billionth barrel of crude in 16 years of operation.

The refinery processes Lake Maracaibo crude principally. Its large volume output includes all grades of aviation gasoline, motor gasoline, kerosine, diesel fuel, distillate fuel oils, residual oils, and cutback asphalt. The remainder of Aruba's output consists of lubricating oil base stocks, which are exported for finishing and smaller quantities of other products.

Some of the equipment includes an atmospheric pipe still of 16,000 bbl. per day, a 28,000 bbl. per day combination

Pre-war photograph of gasoline recovery plant, Port Jerome Refinery, Rouen, France, of Standard Francaise des Petroles.



Elevation view of Aruba Refinery of Lago Oil and Transport Company, Ltd., showing refinery and tank farm.

atmospheric and vacuum pipe, four 8000 bbl. per day crude stills, four combination thermal units of 22,000 bbl. per day and four of 25,000 bbl. per day, three vis-breakers of 22,000 bbl. per day, each, plus special aviation gasoline equipment. The storage capacity of the refinery tanks totals 13,500,000 bbl.

There is, in addition, a 160-ton-per-day sulphuric acid plant to supply Aruba and a nearby plant on Curacao, and a naphthenic acid plant that supplied a substantial part of the United States' wartime requirement of this product.

Sometime before the war, Aruba was equipped with an aviation gasoline rerun still, a polymerization unit, and a hydrogenation plant for the production of hydrocodimer, the principal aviation gasoline blending agent before the advent of the alkylation process in 1938. Later, an alkylation unit was added, and in 1941 the entire aviation gasoline operations of the refinery were expanded. To the existing equipment were added a 15,500 bbl. per day charge capacity fluid catalyst cracking plant and a gas scrubbing unit, a new alkylation unit, an isomerization unit, a low pressure gas collecting and compressor plant, a deisobutanizer, a boiler and power plant, tankage and general facilities. Changes were also made in existing facilities to increase the recovery of active butanes.

Cuba

The only petroleum refinery in Cuba is the Belot Refinery near Havana operated by the Standard Oil Company of Cuba. The refinery now has a capacity of 3500 bbl. per day of crude brought from the Texas-Louisiana area, and manufactures white products, middle distillates, lubricating oils and greases, asphalt, and petroleum gases.

Venezuela

Creole Petroleum Corporation oper-

#4 in a series of advertisements discussing postwar refining processes.

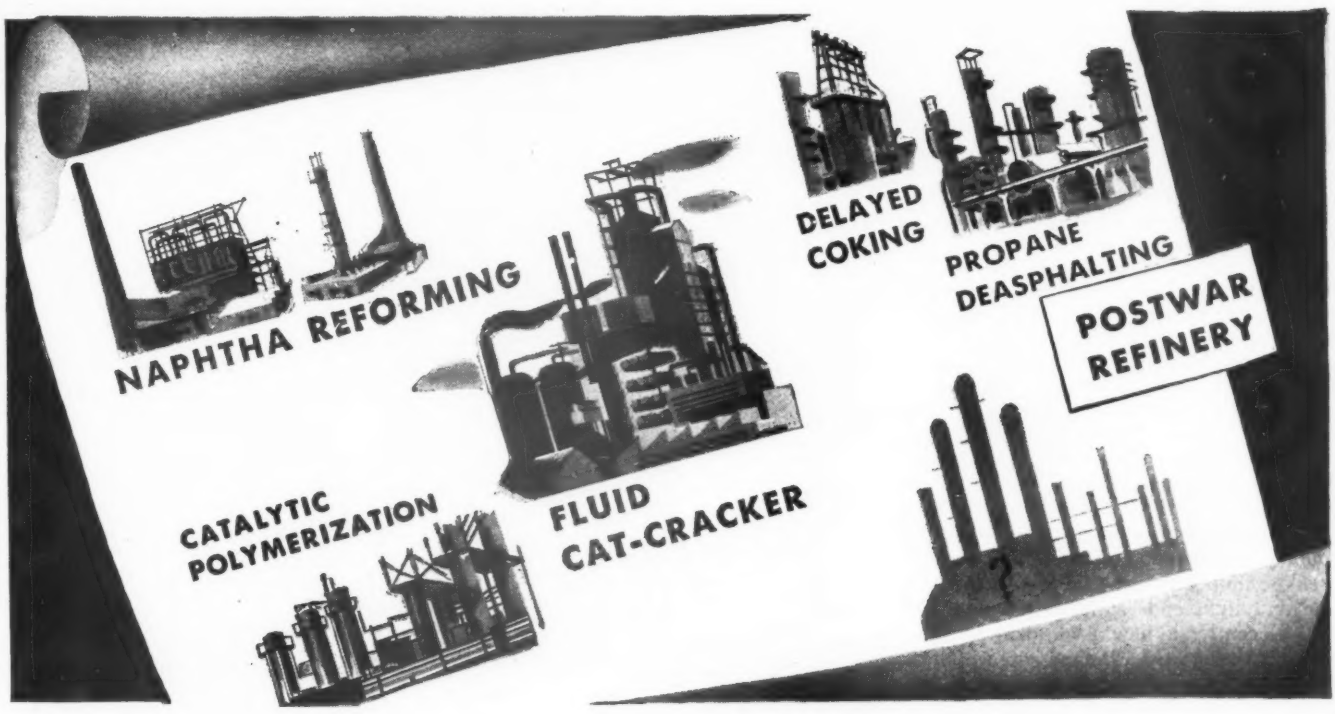
CATALYTIC POLYMERIZATION
for maximum efficiency in utilization of Fluid "Cat-Cracker" Yields

THE ECONOMIC ADVANTAGES inherent in catalytic polymerization of gases to produce a product suitable for stepping up both the yield and quality of motor gasolines is widely recognized. The reason for this is, of course, that gas products from catalytic-cracking are normally highly olefinic.

To begin with, in catalytic polymerization, the resulting polymer is uniformly high grade, motor gasoline. Second, installation costs are low for the catalytic process since it requires temperatures of only 500° F. Third, these low temperatures obviously contribute to overall low operating costs.

Here is a single example of the performance that can be expected of a Kellogg catalytic installation. Polymerization of the gases from a 20,000 barrel *Fluid* "cat-cracker" can produce as much as 1500 barrels per day of high octane gasoline at a direct operating cost of 1.5¢ per gallon *including royalty* . . . resulting in an extremely short payout-time on capital investment.

Of course, figures vary with the individual case. Kellogg will be glad to examine the feasibility of installing new or expanding existing catalytic polymerization facilities.



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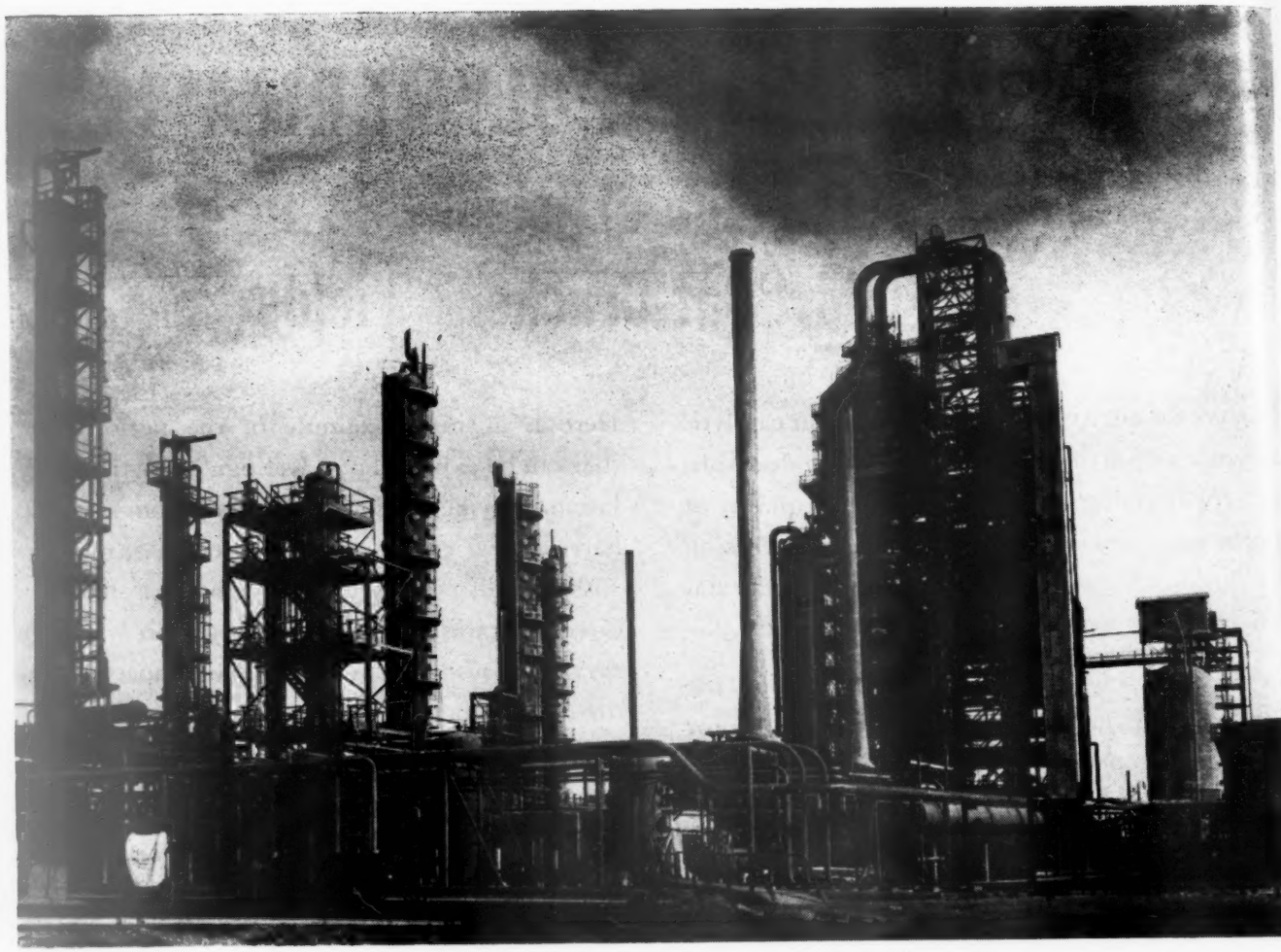
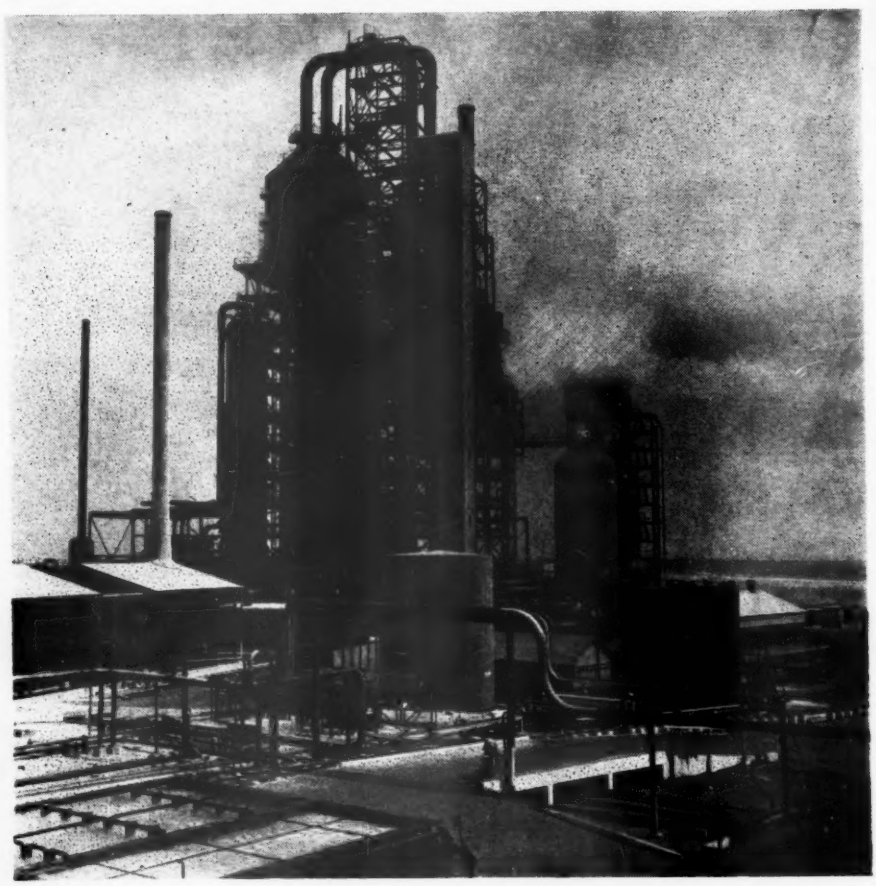


High octane unit and two views of catalytic plant at Aruba Refinery of Lago.

ates the La Salina Refinery at Cabimas, Venezuela. La Salina has a capacity of 8000 bbl. per day of various Venezuelan crudes from which are produced naphtha, gasoline, kerosine, light diesel and fuel oils, and asphalt.

The Caripito Refinery, also operated by the Creole Petroleum Corporation, is situated in the town of Caripito, Monagas, Venezuela. Originally built to operate on the heavy Quiriquire crude with a capacity of 38,000 bbl. per day, Caripito operation was modified to meet military needs. In this special operation the refinery can run to 20,000 bbl. per day of the lighter Jusepin crude and 25,000 bbl. per day of Quiriquire crude.

The physical equipment consists of a combination crude topping and visbreaker unit with integral gas absorption and light ends stabilization facilities. Recently, a new flash drum and fractionating tower were added, which allows the refinery to run the two crudes simultaneously. Products include gasoline, kerosine, light and heavy diesel fuels, Navy special and heavy bunker fuel oils. Special cuts were made during the war, which were finished at other refineries, to augment the aviation gasoline program. Other equipment includes a powerhouse with a total capacity of 12,000 kw. to supply the refinery and



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A valuable electronic tool for geophysical exploration, seismograph surveys and general laboratory research in the oil industry. The enormous range of voltages—five hundred million to one—is accurately covered by our Model 300 Electronic Voltmeter and the accessories shown above. Frequency range 10 to 150,000 cycles. Accuracy 2% over the complete range of operation. Five decade ranges with logarithmic scale make readings especially easy. May also be used as a highly stable amplifier, 70 DB gain, flat to 150,000 cycles.

Send for Bulletin 80 for complete data.

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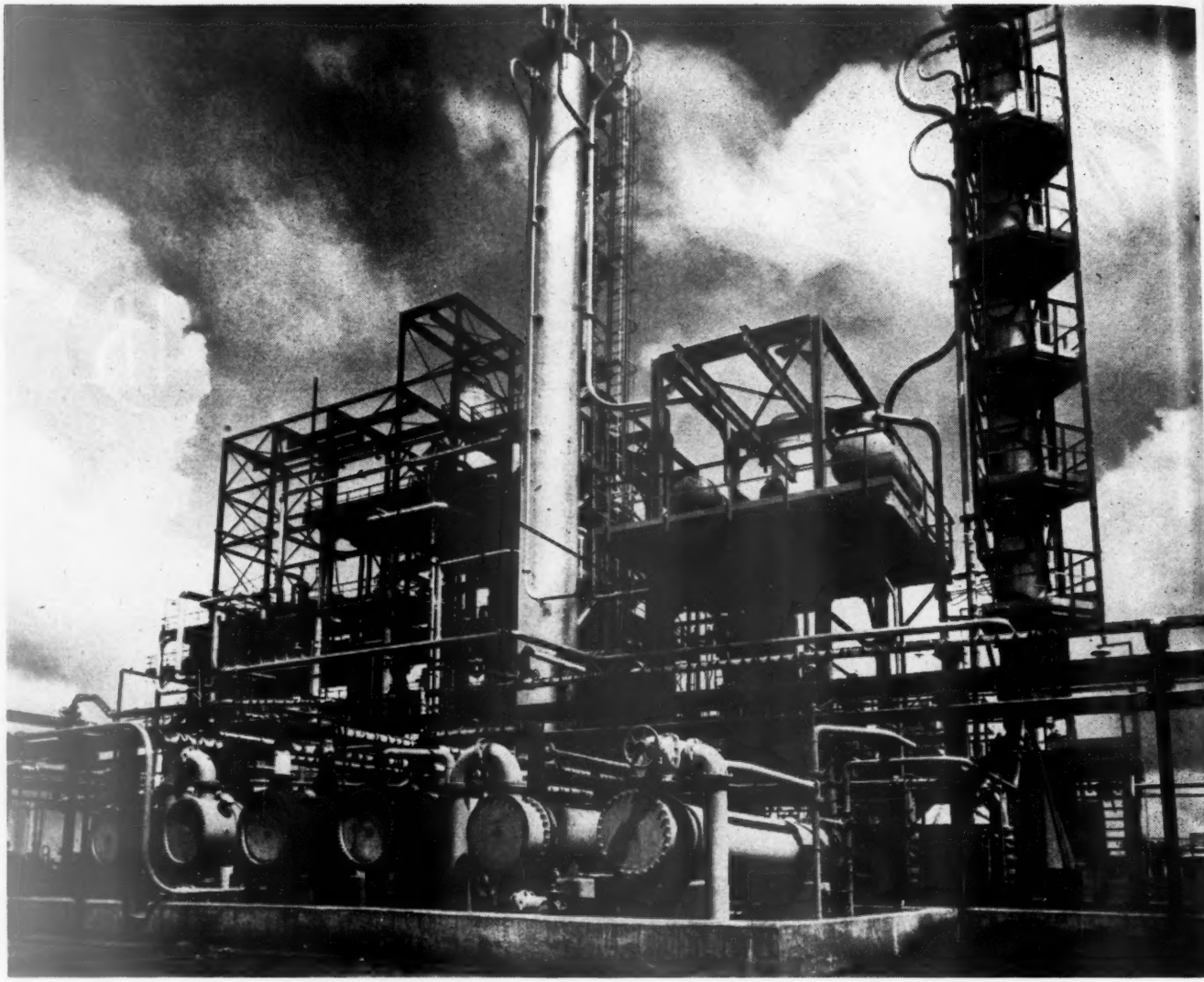

Caripito Refinery of Creole Petroleum Corporation, Venezuela, showing fractionator and light ends stabilization facilities.

the nearby Quiriquire producing field.

Turiamo. Creole Petroleum Corporation is at present preparing plans for a new $50,000,000 refinery in the state of Aragua, Venezuela. Of this amount, $10,000,000 will be used in the construction of hospitals, schools, living quarters, and similar installations, and approximately $40,000,000 will be spent in building the refinery proper.

Turiamo will have a capacity of at least 40,000 bbl. per day of Venezuelan crude and will manufacture aviation gasoline, motor gasoline, kerosine, industrial lubricants, automotive and marine diesel fuels, lubricating oils of all types, greases, industrial and marine bunker fuels, and asphalts. The refinery will incorporate many new developments in equipment design including an improved fluid catalytic cracking unit. Storage capacity of 4,000,000 bbl., a power plant, and a water treating plant will also be built at Turiamo.

The location of Turiamo is such that it will be able to utilize both Eastern and Western Venezuelan crudes, and its harbor offers excellent shipping facilities. Plans for the new refinery climaxed approximately two years of exhaustive study of water supply, harbor depths, living conditions, land contours, climate, food supply, incidence of disease, crude supply, and other factors.

Argentina

Fifty miles north of Buenos Aires is the Campana Refinery of Compania Nativa de Petroleos, S.A. This refinery includes pipe and shell stills of 16,000 bbl. per day capacity. Other equipment consists of vacuum rerun pipe still for lubricating oils, and two cracking coils. Products made at Campana are aviation gasoline, middle distillates, high grade lubricating oils, white products, greases, and asphalt.

Bahia Blanca Refinery is approximately 400 miles south of Buenos Aires. Equipment consists of shell stills and a cracking coil. The total rated capacity is 3000 bbl. per day. Products of this refinery include white products, middle distillates, and asphalt.

Two smaller refineries in Argentina are Manuel Elordi and Dadin with capacities of 1000 and 300 bbl. per day, respectively.

Although these Argentine refineries run on indigenous crude when possible, the supply does not equal demand nor refinery capacity. Importation of other crudes is usually necessary, the sources in the past being Peru, Colombia, and Venezuela.

East Indies

Soengei Gerong, Sumatra, was the site of a refinery of the Nederlandsche Koloniale Petroleum Maatschappij. Just as the Japs moved into Sumatra, this refinery was destroyed by the Netherlands Indies Military, according to a preconceived plan developed after much study. The small amount of information available on the condition of the refinery and nearby producing sites is at present too sketchy to enable us to form a definite idea of what future plans must be in the rehabilitation of Soengei Gerong.

★ ★ ★

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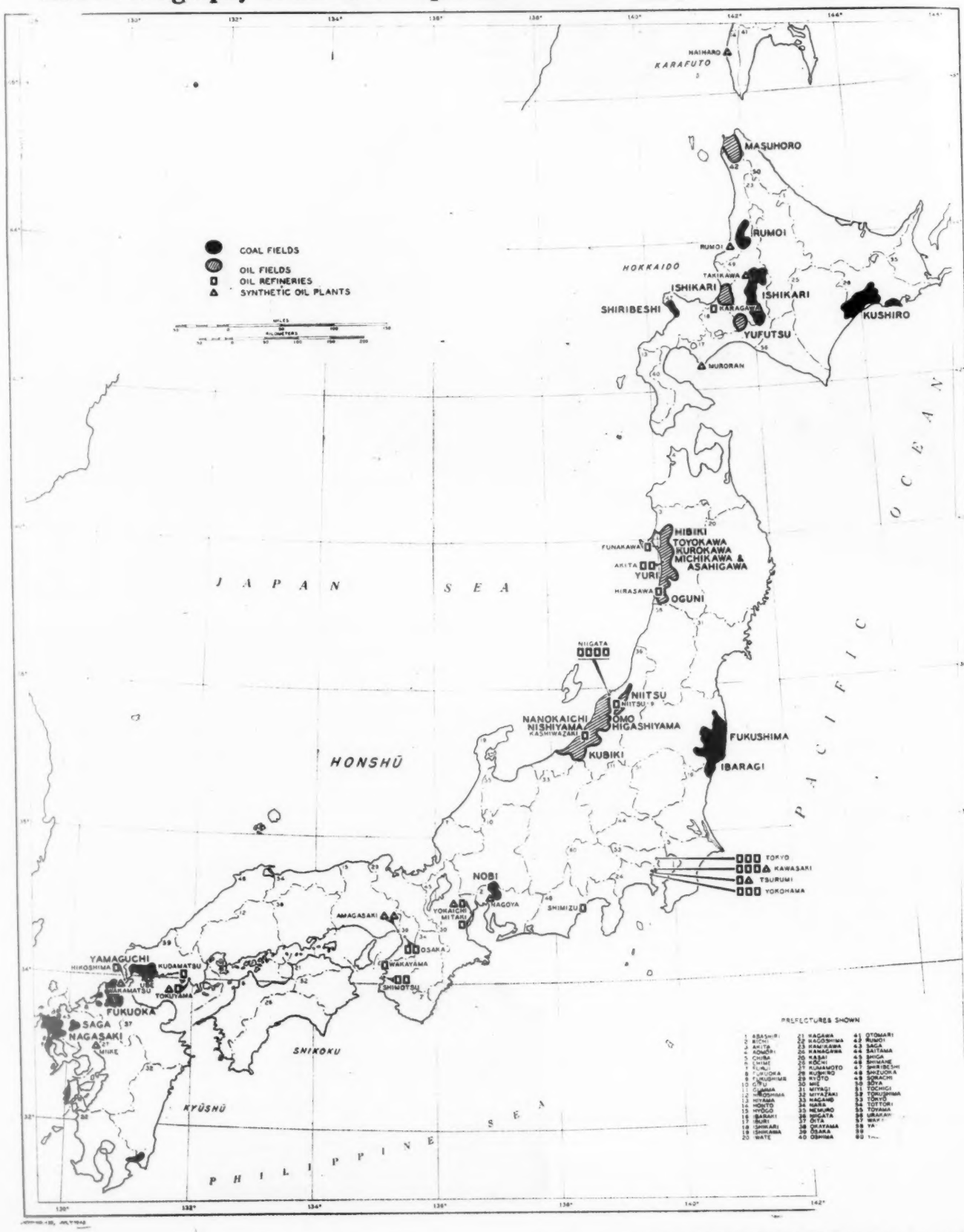
Oil and Coal Fields of Japan

This map indicates not only oil and coal reserves but also oil refineries and synthetic oil plants. It was compiled by the Foreign Minerals Division, Bureau of Mines, United States Department of the Interior, and prepared by the Division of Geography of the same department. It was completed in July, 1945.



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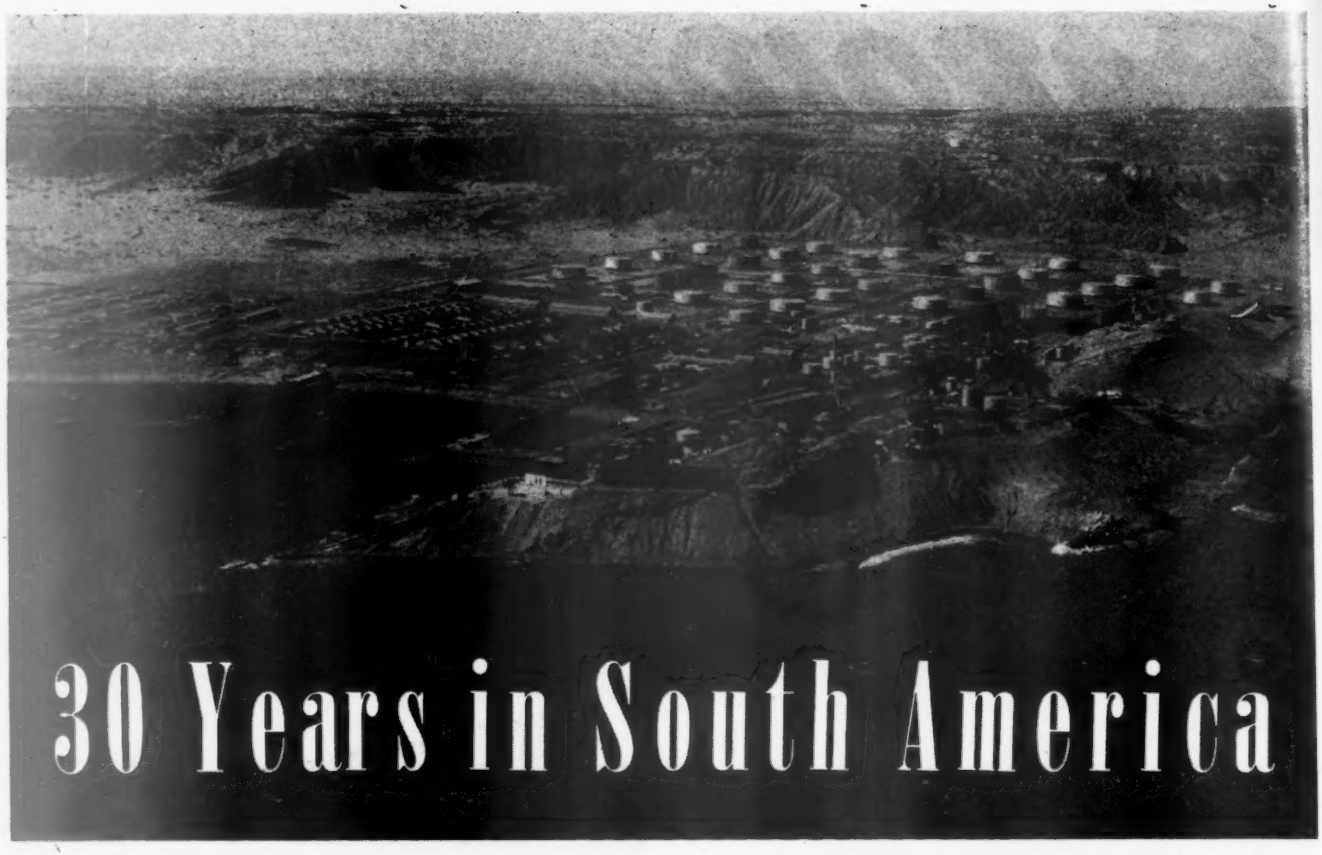

30 Years in South America

Airview of Talara, Peru, showing International Petroleum Company, Ltd., refinery and port.

INTERNATIONAL PETROLEUM COMPANY, LTD. operates in three of the South American republics: Peru, Colombia, Ecuador. In Peru the parent company's activities are confined to development of La Brea y Parinas Estate; in Colombia, in addition to exploitation of the De Mares Concession, considerable exploration is being conducted in the Coastal and Magdalena Valley areas by the Tropical Oil Company, Ltd.; in Ecuador operations are wholly exploratory, including the drilling of wildcat and stratigraphic tests, under the direction of the International Ecuadorean Petroleum Company.

EXCLUSIVE

Development in South America generally has been greatly curtailed during the war years, in spite of the fact that the demand for petroleum was never more clamant. Existing markets were either entirely shut off, or access to them was extremely hazardous. Tanker schedules were disrupted to provide the largest possible numbers on the shortest possible essential routes. As the conflagration spread the shortage of materials and the lack of technical staffs reacted heavily on exploration and curtailed development of fields already in production. It is safe to say that, during this period, no discovery of major importance was reported from any of South America's potential fields and although the producing countries added to their proved reserves, this was accounted for by modest expansion of existing fields, principally through marginal drilling.

With allied ascendancy on the high seas and large additions to the tanker fleets, together with increasing demands for oil as the tempo of the European war reached a climax, export conditions improved in 1943 and some fields regained their prewar production totals, going on to establish new records in the succeeding year. With additional material being made available and by making the most of the accessible pool of technical men, exploration took on a new impetus which, in Venezuela and Colombia in particular, exceeded the previous peak activity.

These general trends are representative of the course followed by International Petroleum in the war years.

Peru

International entered the Peruvian field in 1914, acquiring La Brea y Parinas properties on which development had been proceeding for some years. Apart from an effort to enlarge the area of production around the estate's boundaries in the years from 1922-30, (when over a million acres were secured by concession from the Government and 21 wildcat wells drilled a total depth of 61,224 ft. without encouraging results), the company has confined its activities to developing and extending the resources of the property.

La Brea y Parinas has an area of 411,315 acres, approximately one-sixth of which is composed of rocks that are not oil-bearing. Over the major portion of the field the rocks are Eocene in age, consisting of alternating sandstones and shales of considerable thickness. A large part of the area is traversed by an intricate system of normal fault-blocks, these faults often serving as marginal barriers to the migration of oil.

Early production was from the Negritos and Parinas formations, the former providing wells of long life but small capacity, whereas Parinas wells usually had settled production of from 50 to 60 bbl. Subsequent operations established the presence of other productive horizons, of which the most prolific were the Verdun and Lomitos formations, some wells in the latter having large initial capacities.

Prior to International's acquiral of the field, La Brea y Parinas had produced 8,462,932 bbl. of oil as the result of drilling 865 wells, of which 685 were producers and 180 abandoned for one reason

(Continued on Page 146)

International Petroleum, subsidiary of Imperial Oil Limited, started its enterprises in Peru. Now it also operates in Colombia and Ecuador.

MODEL 0 DRAW WORKS

★★★ FEATURES

Manually controlled Twin Disc friction clutches drive the pump, draw works, and rotary table.

"Cardwell" chain transmission has three speeds forward and one reverse. Pumped oil lubrication is provided to all chains and bearings with oil pressure gauge in front of driller. Dual drum drives provide six speeds forward and two reverse to the lower drum, with all hoisting speeds instantly available.

When rotating, no drives are running except to the rotary table, although catheads or drum may be engaged without stopping rotary table or slush pump.

Frame with three structural members running full length gives maximum strength and rigidity.

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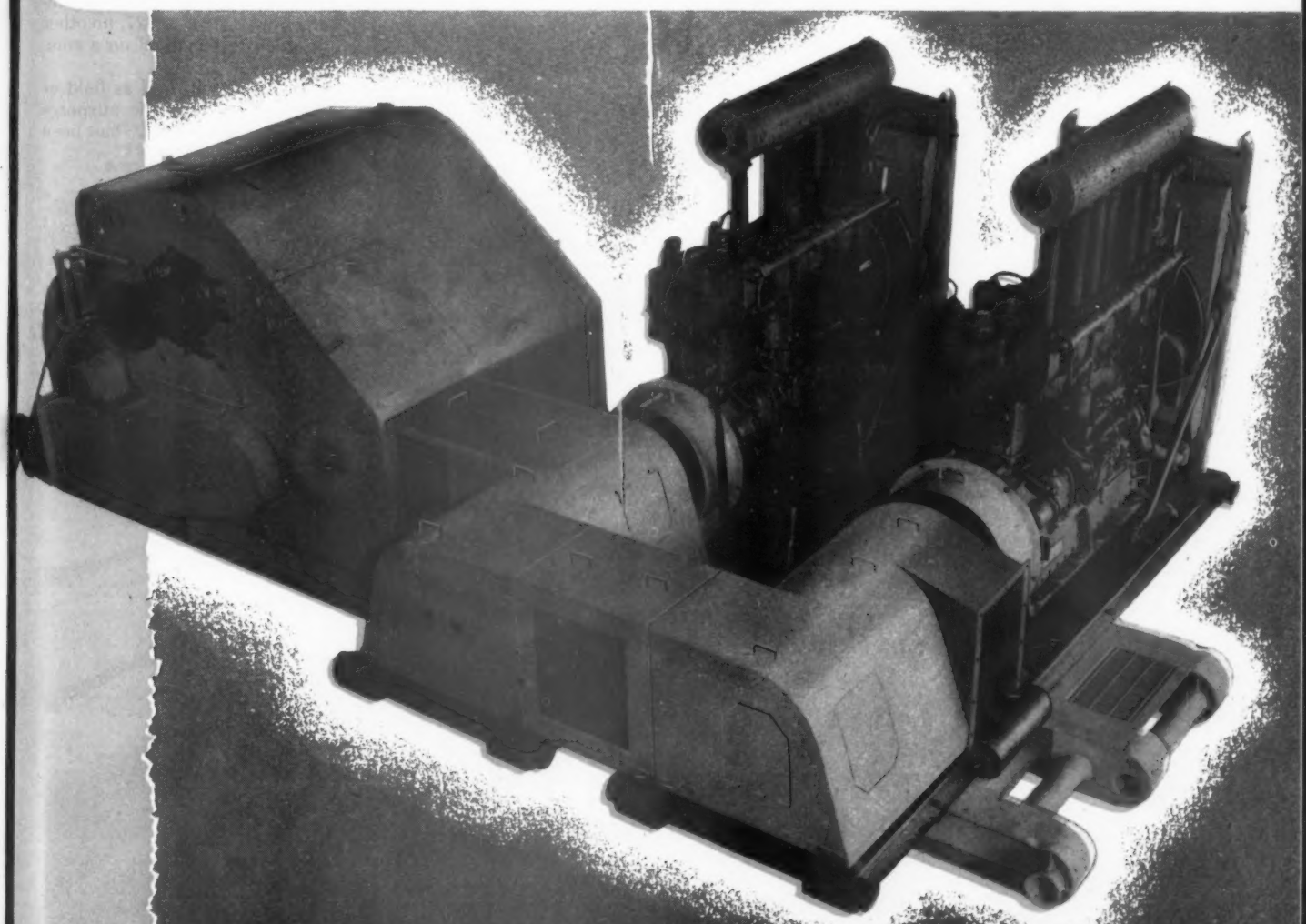
Optional sand line drum assembly mounts on countershaft, making a double drum draw works.



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(Continued from Page 142)

or another. The total footage of all wells drilled was 999,681 ft.

By the close of 1944 total production from the field had reached 257,233,358 bbl.; 3524 wells had been drilled of which 2273 produced and 1251 were abandoned as dry or on account of drilling difficulties and a total of 6,513,809 ft. had been drilled, inclusive of well-deepening operations.

The field saw its greatest activity in 1929 when 205 wells were put down, 177 of which were productive. The peak of production was reached in 1936, with 15,126,490 bbl.

Production held up amazingly well during the war years, the totals being:

1939	10,806,880 bbl.
1940	9,626,831 bbl.
1941	10,362,395 bbl.
1942	11,089,586 bbl.
1943	12,055,098 bbl.
1944	11,763,083 bbl.

In the same period drilling operations were accelerated at the outbreak of hostilities and then levelled off, comparative figures showing:

Year	Total wells drilled	Footage	Producing	Dry
1939	73	198,449	56	17
1940	139	307,060	123	16
1941	66	194,173	62	4
1942	69	230,389	60	9
1943	72	272,632	59	13
1944	67	295,710	48	19

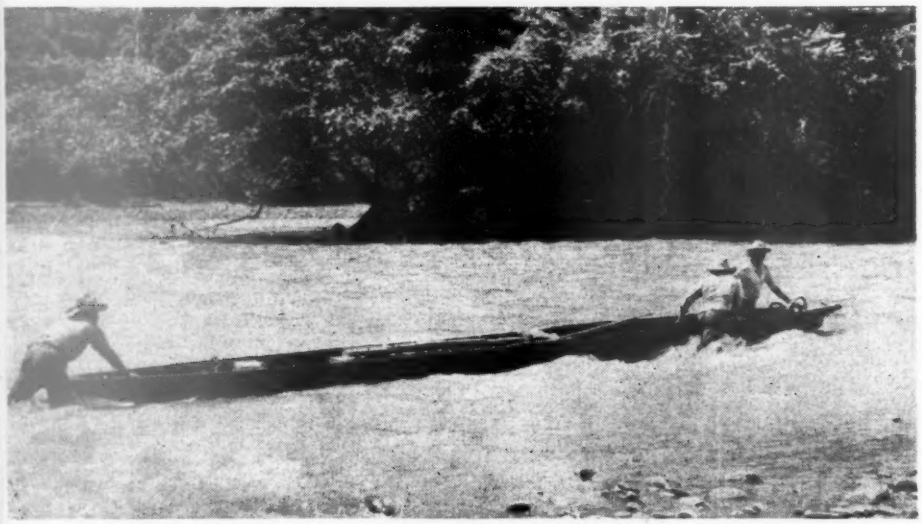
Although not boasting the largest number of wells completed, 1940 showed the greatest footage drilled in any year of the field's history whereas, in consideration of the extension of wildcat drilling over this period, the percentage of dry holes was remarkably low.

Rotary, cable-standard, and cable-star methods of drilling are employed, the last mentioned confined to deepening and work-over projects while 85 per cent of all drilling is by rotary. Peruvian labor has proved apt in acquiring the technique of drilling and many crews are wholly drawn from this source.

La Brea y Parinas, enjoying the advantages of unit operation, was a pioneer in the field of repressuring and pressure maintenance for, when International inaugurated repressuring in 1927, no other field had applied this method on a comparable scale.

Gas was originally utilized as field or refinery fuel and for domestic purposes in the camps and, since 1922, has been

Geological party on Rio Corare, Colombia. River is too swift for poling.



Landing drilling material at La Libertad, Ecuador.

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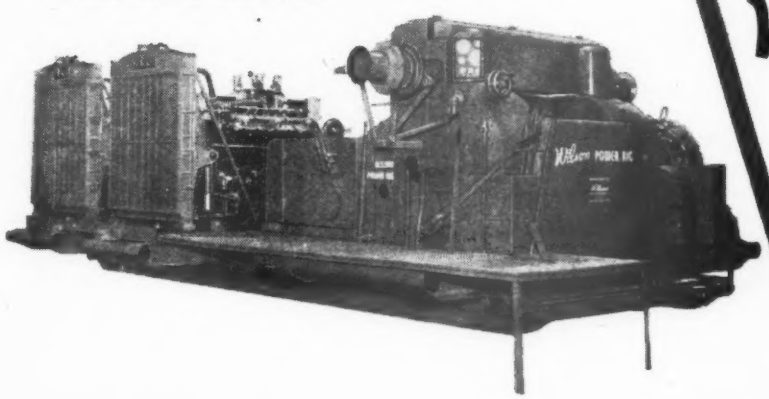

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Core drilling with a portable rig at Rodeo, Ecuador.

treated in a series of casinghead gasoline plants before being directed to its several uses. In 1927 half of the 32 million cu. ft. of gas produced, after being stripped, was devoted to gas-lift and repressuring and this percentage has been steadily increased as new compression units became available until in 1944 gas returned to the sands represented 98.3 per cent of that produced.

At Talara the company operates a thoroughly modern refinery with a skimming capacity of 40,000 bbl. daily. This is also the shipping port, possessing one of the finest harbors on the western coast of South America, developed to accommodate the largest type of ocean-going tankers.

The company has maintained an efficient geological department in the field since 1920 and has conducted geophysical examinations over a large part of the Estate.

Colombia

The De Bares Concession, which comprises 1,318,787 acres, is situated some 400 miles into the interior of Colombia, in the Magdelena Valley. Originally granted to a French engineer, Roberto de Mares, its initial development was financed by a Pittsburgh group which launched the Tropical Oil Company. The time was not well chosen, for World War No. 1 was raging and, as one of its minor complications, the United States had imposed an embargo on the export of oil-drilling equipment.

Tropical's first well was drilled with a unit assembled from the derelict stock-in-trade of a company which had unsuccessfully tested an area on the Colombian coast and which was laboriously transported to a location some 18 miles back from the Magdelena river at Barranca Bermeja.

This initial test proving successful it was found possible to ship two rotary rigs from Pittsburgh, each of which was responsible for a producing well so that, by the end of 1918, there were three wells on the property.

It was early apparent that exploitation of the De Mares Concession called for an effort and outlay which Tropical, as then constituted, was not in a position to guarantee and, in 1920, International Petroleum Company, Ltd., obtained control, thus assuring adequate development of this property.

As a preliminary, International undertook an extensive program of road-building and commenced detailed geologic and topographic surveys.

The rocks covering the concession are Tertiary in age (Eocene and Oligocene) and the structural geology is not complex. The original wells were drilled on the Infantas anticline and subsequent operations have proved one other structure, La Cira. Production is obtained from well-defined zones and it is usually possible to estimate, with a reasonable degree of accuracy, the depth to which a test must be prepared to drill. This allows of the almost exclusive use of the rotary system, cable tools only being utilized for special work. Wells are generally completed with one string of casing.

Although Cretaceous rocks have been penetrated in the drilling, no production is meanwhile developed from that source.

The Infantas structure was originally developed but when, in 1926, the first well on La Cira gave an intial flow of 385 bbl. daily from a depth of 2083 feet, primary attention was devoted to this structure, which now supplies the major portion of the total production.

Up to the close of 1939 the total number of wells drilled on the concession was 1090, of which 1053 were productive and 37 abandoned. Footage amounted to 3,084,724 ft. The impact of war is easily noticeable on the statistics for the succeeding years:

Year	Wells drilled	Footage	Productive	Abandoned
1940	77	206,188	72	5
1941	16	49,909	14	2
1942	6	26,247	4	2
1943	3	18,673	3	0
1944	4	7,969	4	0

This brings the total of wells drilled

A Peruvian wildcat about 20 miles from Talara on La Brea y Parinas Estate.

to 1196, of which 1150 are productive and 46 were abandoned. Total depth drilled is 3,393,710 ft.

Production, which to the end of 1939 amounted to 250,156,967 bbl., hit the same wartime snag:

1940	**21,426,492 bbl.**
1941	**20,785,309 bbl.**
1942	**9,453,995 bbl.**
1943	**11,644,438 bbl.**
1944	**18,082,226 bbl.**

This gives a total, to the end of 1944, of 331,549,427 bbl.

To utilize the gas produced in the field, five absorption plants, with a combined daily capacity of over 75 million cu. ft., are in operation. Stripped gas is used in the plants, field and refinery and some 30 per cent of the total is devoted to repressuring.

During 1944 upwards of 45 million gal. of condensate was recovered by the operation of those plants, the yield varying from 1.17 to 3.45 gal. per thousand and averaging 1.86.

Both geological and geophysical surveys are still being continued on the concession as approximately only one-sixth of its area is under development and the possibilities of the remainder are far from exhausted. Reservoir conditions are the subject of careful study; coring is general in all wells and electric and gamma ray logging has been widely used.

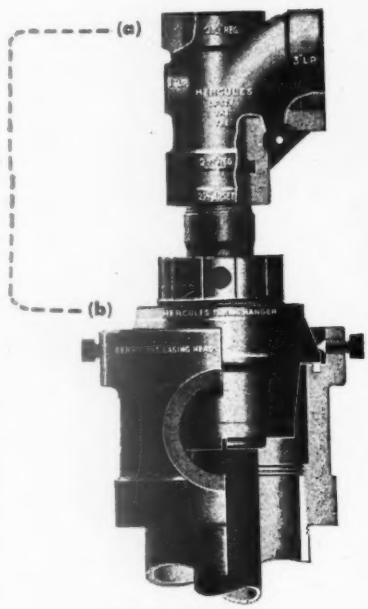
During its tenure of the De Mares Concession Tropical Oil has overcome climatic and geographic handicaps in turning the area into a modern and model hive of industry. Roads, railways and bridges have been built; towns have sprung up with every essential to healthful and comfortable living; a large Colombian population has been emancipated from drudgery and disease and trained in those branches of engineering and construction which are essential to the science of oil recovery.

But the coming of petroleum has had more than local repercussions.

To meet Colombia's internal demand for refined products, which took a tremendous leap once domestic production obviated the long and costly haul for imported supplies, Tropical erected a refinery, (now enlarged to a potential of 16,200 bbl. daily) at Barranca and established bulk storage at strategic points throughout the country. In 1920, Colombia's meager needs for petroleum were met by the importation of 63,790 bbl. of crude; within ten years (in 1929) 1,784,067 bbl. of Colombia's own production was necessary to meet her requirements and she was exporting over 18 million bbl.

Before export was possible it was necessary to construct a pipe line from the field to the coast and this was undertaken by the Andian National Corporation. It was a herculean undertaking but, although the first shipment of pipe was not unloaded at Cartagena until March, 1925, the valves were opened and the system started to function in May, 1926; Colombia's first export of crude oil, 80,000 bbl., cleared from Mamonal in the first week of July of that year.

In view of the wide-spread interest being devoted to Colombia's oil possi-



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bilities, Tropical Oil is meanwhile carrying on investigations both in the Magdelena Valley and the coastal areas, having both geological and geophysical parties in the field. So far five wildcat wells have been drilled at widely separated locations and further tests are pending.

Ecuador

The producing area in Ecuador is confined to the Santa Elena peninsula and stems from an era of hand-dug pits dating back to the days of the Spaniards. Although several deep tests have been put down within the confines of the field, none has developed appreciable production below the shallow horizons of the Ancon and Azucar formations of the Eocene.

International Petroleum entered the Ecuadorian field in 1914, securing scattered leases in the Santa Elena area totalling over 5000 hectares and larger blocks in virgin territory at Manta and Manglaralto. After unsuccessfully testing these latter areas by putting down two holes they were relinquished.

On the Santa Elena holdings a test well was completed as a small producer at 3175 ft. and, eventually, seven shallow wells were drilled with a star rig on this lease through arrangement with Ecuadorian Oilfields, Ltd., giving modest production which, in 1944, had declined to 751 bbl.

During the years between 1925 and 1939 concessions of considerable extent were, from time to time, obtained from the Ecuadorian government, geologic and sub-surface surveys initiated and test-drilling undertaken.

Near Zapotal heavy gas flows were encountered in a well drilled to 3565 ft. and this led to a joint drilling venture with Standard of California, which held adjoining leases. At the comparatively shallow depth of 1260 ft. this test entered a badly faulted zone and was abandoned.

Early in 1939 arrangements were made with the government for the Daule Study Concession, an area of 4 million hectares lying between the Gulf of Guayaquil and the Department of Esmeraldas. This concession was for a term of four years, during which time the company undertook to conduct geological and geophysical surveys, carry on core and deep drilling and do necessary construction work to facilitate these operations. At the completion of the exploratory period the company had the privilege of selecting 400,000 hectares for development under the existing Petroleum Law.

This agreement inaugurated a sustained and comprehensive investigation by practically every scientific method known to oil-seekers. Geological surveys succeeded in establishing the stratigraphic relationship and structural features over a wide area in which a number of structural units, each representing its own problems and holding its own promise, were defined.

It was also made manifest by these surveys that, over a large part of southwestern Ecuador, the oil prospects could only be determined by geophysical methods and stratigraphic drilling, owing to a lack of surface exposures and extensive overlapping of the various formations.

Reconnaissance exploration by gravimetric and magnetic methods was begun early in 1940 and, late in 1941 seismic methods were introduced and refraction profiles run; subsequent reflection methods have found greater favor.

To augment the information thus gained, over 50 core holes were put down during the years 1939-42; a portable rig was used and the holes had a maximum depth of 1600 ft.

Wildcat tests were sunk at four locations:

Rodeo	**5740 ft.**
Barbasco	**5847 ft.**
Data	**5100 ft.**
Lechuza	**7503 ft.**

These were all put down by rotary and extensively cored but, apart from gas shows and an occasional trace of oil, no success was attained. They did, however, provide valuable stratigraphic information.

At the close of 1942 International Petroleum withdrew from active participation in these developments, its interest in the Daule Concession being merged with similar holdings of Standard of New Jersey and future operations entrusted to the International Ecuadorean Petroleum Company, in which International Petroleum and New Jersey each retained an interest.

The new organization carried on and intensified the exploratory work, in spite of the increasing difficulty in obtaining materials and trained scientific personnel. Core-drilling totalled 17,123 ft. in 1943 and 13,534 ft. in 1944, while the footage of test wells was 27,620 ft. and 21,501 ft. in these years respectively.

The following wells have been completed:

Solano	**6181 ft.**
Daular No. 1	**7725 ft.**
Carrizal	**7115 ft.**
Camarones	**5118 ft.**
Febres Cordero	**6365 ft.**
Daular No. 2	**8420 ft.**
Las Canas	**7006 ft.**
Engunga	**7440 ft.**

None of these tests procured production.

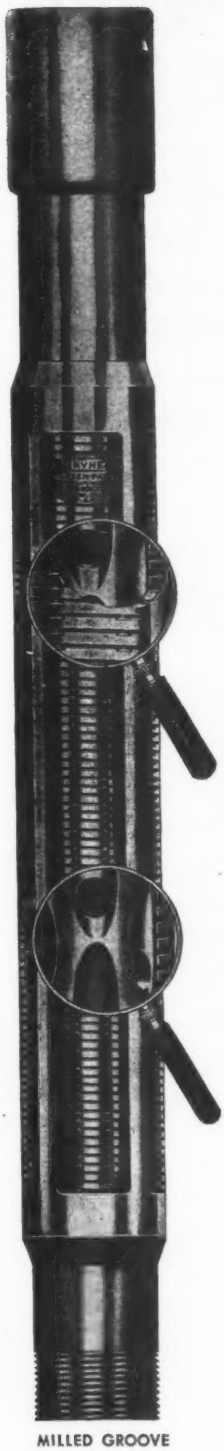
Under the provisions of the various concessions affected, final selection has now been made of areas considered as deserving of still further investigation and operations are continuing with unabated vigor. Three test wells are at present drilling and geological and seismograph parties are in the field.

Although the main result of investigations thus far has merely been to fine down the area of search, continuing operations should go a long way towards determining whether the coastal area of Ecuador can be depended upon to augment the petroleum resources of the country, represented meanwhile by the dwindling assets of Santa Elena.

★ ★ ★

Editor's note: We are indebted to W. Frank Prendergast, assistant to the president of Imperial Oil Limited, for the material and photographs presented here.

DEPENDABLE PRODUCTS



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Union Oil Operations in Paraguay

By
RICHARD SNEDDON
Pacific Coast Editor

Geophysical equipment at temporary camp in Santa Rosa.

EXCLUSIVE

In September 1943, Union Oil Company of California sent its first geological mission to Paraguay. Under the direction of Earl Noble the group, which included Max Kreuger and Charles Cassel, made reconnaissance trips over various sections of the country, studying the general character of the terrain as far as conditions would permit. Following this survey, negotiations were begun with the Paraguayan government and eventually joint deliberations crystallized in an agreement.

Early this year details of the agreement were made public and it was revealed that Union Oil Company has been given the right to prospect for petroleum in the Chaco territory of Paraguay, involving a vast area of 56,000,000 acres. Up to that time the area was completely untested but geologists remarked that the Paraguayan Chaco is contiguous to the oil districts of Bolivia and appeared to be a continuation of the Argentine Chaco, in which are known geological structures.

The agreement stipulated that Union Oil Company was to explore for oil, and to produce, transport, refine and market it in the event of its discovery. Union, it was further agreed, was to provide such exploration equipment and personnel as might be necessary, and subsequently, also, provide the additional supervisory personnel to build a Paraguayan oil industry if it were found economically sound to do so. This was a pretentious project that offered many difficulties, but difficulties are more incentive than deterrent to the oil industry, and as soon as an orderly plan could be developed and essential equipment could be produced and assembled, the first steps in the program were taken.

It was realized from the start that the productive possibilities of the terrain were quite unpredictable since it exhibits almost no outcroppings or other surface indications of subterranean structure. It is heavily wooded, with occasional grassy areas, and virtually no roads, so that exploration in itself offered problems of major dimension. Although both parties to the agreement recognized these obstacles, and although neither en-

Left, A. C. Rubel, vice president of Union who made agreement with Union and Paraguay, welcomes His Excellency Captain Ramon Martino, Paraguayan minister of public works, to Los Angeles. Right, Reese Taylor, president of Union, talks over the Paraguayan agreement with Dr. Oscar Perez Uribe, right, and Senor Pedro Ferrari, left.

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Left, entrance to Union Oil Company's office at Asuncion. Below, office of Chester Cassel, resident manager of Paraguay operations for Union Oil Company.

gaged in any optimistic speculation on the eventual outcome of the adventure, the actual completion of the negotiations and the drafting of an agreement was proof enough of their faith in the enterprise. The preliminary overtures were made by A. C. Rubel, vice-president of Union Oil Company, who, with the appointed delegates of the Paraguayan Government finally drew up the terms of the agreement.

That part of Western Paraguay called the "Gran Chaco" is all of the area lying to the west of Rio Paraguayan, which runs north and south, virtually dividing the country in half. It is comprised of some 56,000,000 acres of comparatively flat, wooded land, with all surface indications, if any, pretty well obscured by the overlay. It thus is not adapted to geological definition and is of necessity being explored by seismic methods.

The first geophysical prospecting crew began operations in the Western Chaco in January 1945 and is still at work, traversing the area from east to west, and preparations are now under way to send a second crew—equipment is already on the way. It is planned to have the first crew engage in reconnaissance surveys only and the second will then develop the detail on all significant findings, or wherever a detailed study is warranted. All the exploration work is being performed by the Western Geophysical Company of Los Angeles.

Map showing the Gran Chaco Area of Paraguay.

Although up to the moment no detail surveying has been done, sufficient information has been developed to indicate that the area is workable by reflection seismograph, and that reflections are clear enough to permit satisfactory interpretations. No revelation has yet been made on structure, however, and it seems to be the impression of all concerned that little can be learned about the stratigraphy until a well has actually been drilled. That may be about July 1946, but as of this time, nothing in this respect is altogether certain.

As might be expected, materials and transportation still offer formidable barriers to speedy accomplishment, but there is distinct hope that some of this trouble will be alleviated in the near future. Supplies, after they arrive in the country have to be carried up the river from Asuncion to Puerto Casado, thence inland in a westerly direction about 160 kilometers on a narrow gage railway, and finally by truck to the working area. There are, as already indicated, few roads in the Paraguayan Chaco, but there is one good road west of Kilometer

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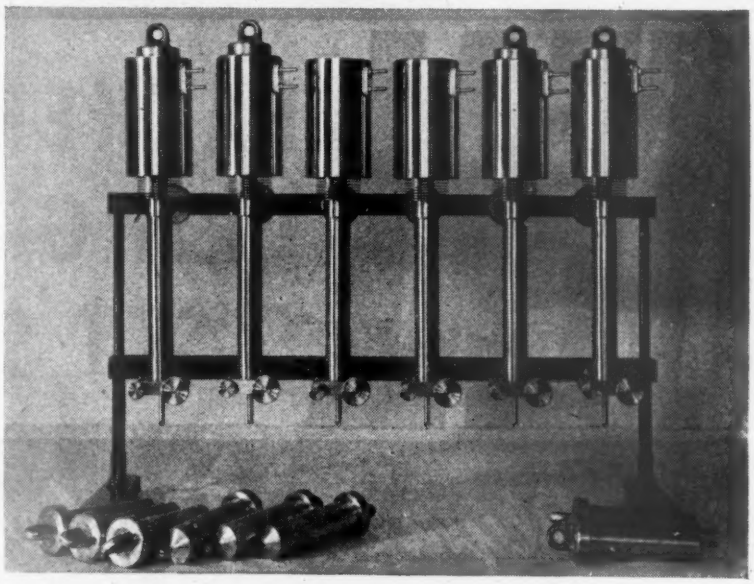

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Earl B. Noble, manager of exploration for Union Oil Company, led the first reconnaissance trip into the territory.

160, and that, of course, is the route being followed. Personnel is moved in partly by plane and partly by the same devious route that has to be taken by the equipment.

Preparations are now under way for the assembly of equipment that will be sent down to the working area in the early part of the year. In the meantime temporary camps have been set up in the field and a local office has been established in Asuncion, with Chester Cassel installed as resident manager for Union Oil Company and Dr. Oscar Perez Uribe as legal advisor on Paraguayan matters. Part of this office is occupied by Western Geophysical Company, whose activities are under the supervision of M. A. Bocallery.

All work is being done with mixed personnel, using United States operators whose experience is necessary and training local help in increasing numbers as the opportunity presents.

It is hoped ultimately that the project will be carried on with a high percentage of Paraguayan personnel, using United States workmen only when special qualifications are required and are not otherwise available.

It is interesting that His Excellency, Captain Ramon Martino, Paraguayan minister of public works and communications and Engineer Fernando Sequier, director of mines, paid a visit to the United States recently to aid in procuring equipment for the projected development program. Minister Martino expressed high hopes that Paraguay would eventually become an important oil producing nation and stated that while no oil had as yet been discovered, geologists of his country and of Union Oil Company had agreed that prospects for oil production in the Gran Chaco are excellent. While in California, the distinguished Paraguayans made an inspection of the State's oil fields, under the guidance of A. C. Rubel. ★ ★ ★

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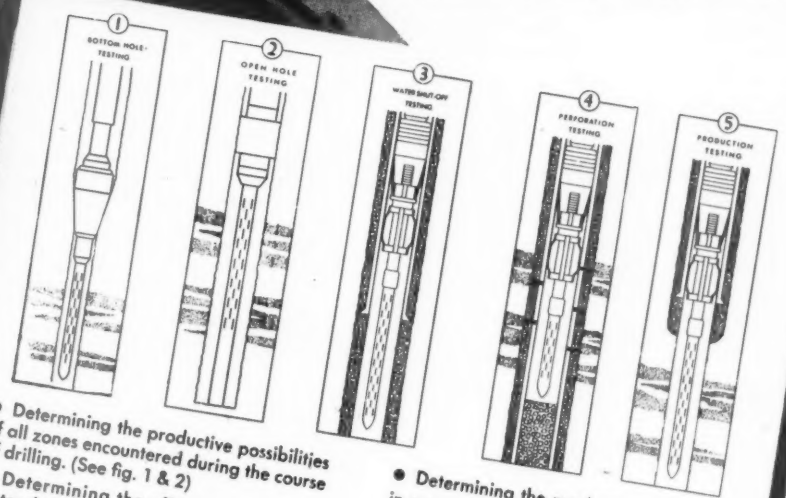

- Determining the productive possibilities of all zones encountered during the course of drilling. (See fig. 1 & 2)
- Determining the effectiveness of the water shut off on cemented casing, whether shoe or squeeze job. (See fig. 3)
- Determining the effectiveness and productive results of perforating jobs in casing. (See fig. 4)
- Determining the productivity of a zone in a completed well before landing a liner or oil string but after the water string is set. (See fig. 5)
- Determining the productivity increase of an acidizing job.
- Determining the exact location of a fracture or leak in casing.

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DEVELOPMENT OF CASABE FIELD

By **E. OSPINA-RACINES**
Petroleum Economist
Bogota, Colombia

EXCLUSIVE

THE President of Colombia, Dr. Alfonso Lopez, on June 6 of this past summer, flew to "Compania Colombiana de Petroleos El Condor" (Shell) Yondo concession, the 46,800-hectare (115,000-acre) grant situated some 180 miles NNW of Bogota on the west bank of the Magdalena River, for the purpose of inaugurating the 30-year period of exploitation and pipe-line shipments to tidewater via the Andian common carrier. The Yondo concession, granted September 15, 1938, is the first grant made under the provisions of Oil Law 37 of 1931, which has reached the pipe-line shipments stage, hence the commercial exploitation period. The De-Mares and Barco grants of 1919 and 1931 operate under special concession contracts.

President Lopez threw the clutch that connected a 90-hp. diesel prime mover with a 7½ by 12 pump, thus inaugurating pipe-line shipments from the Casabe field. Oil from one of the two 40,000-bbl. tanks began flowing along the 10-in. 300-lb. per sq. in. connecting line, across and beneath the Magdalena River to Andian's Galan station. The input station at Casabe has a capacity of 20,000 bbl. per day for the present and an average of 8000 bbl. per day are being taken from the Casabe field where only 15 of the 28 producers are flowing. The other 13 producers are shut in for the present. This gives an average of about 535 bbl. a day for the 15 flowing wells.

The Andian common carrier is in a position to take care of some 25,000 bbl. per day of Casabe oil; 15,000 bbl. a day from additional looping of the line and about 10,000 bbl. a day capacity now available. Total Andian throughput is 70,000 bbl. a day, which is not being fully used.

The Yondo concession enjoys the distinction of being the first grant made under the provisions of the oil law of 1931 to reach the commercial exploitation stage with shipment of crude from the Casabe field. The other two grants, De Mares and Barco, which operate under special contracts of 1919 and 1931, respectively, began pipe-line shipments in 1926 and 1939.

Casabe oil increased Colombia's crude output 17.6 per cent over current 1945 production. De Mares concession during the first quarter produced 5,127,032 bbl. and Barco 1,492,731 bbl. of 24.5-deg. and 45-deg. API oils or an average of 42,700 and 12,400 bbl. a day, respectively. Initial Casabe deliveries averaged 8450 bbl. a day, increasing the country's crude oil output from 55,100 to 63,550 bbl. a day. Gravity of Casabe crude is about 21.5-deg API. It has a high octane aviation base stock, also a good lubricant cut. Motor fuel yield is low.

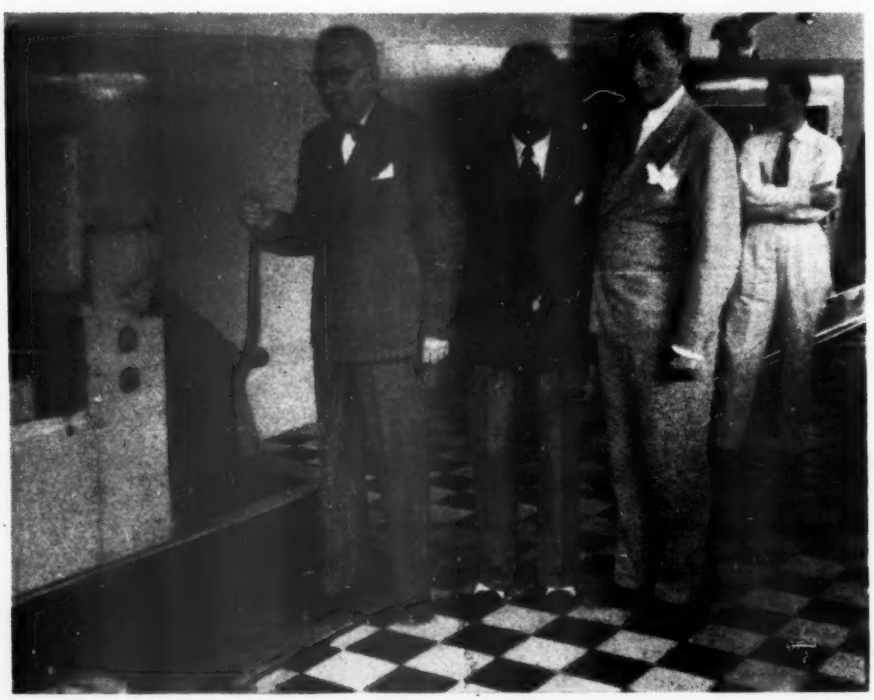
● **Concession.** Condor filed the application for this concession on May 20, 1937, as bid No. 26, bid No. 1 having been filed early in 1931. The latest bid reported is No. 403, revealing the filing of 377 oil concession bids during the 8 years that have elapsed.

Having studied and approved the topographical and geological reports submitted, the Ministry of Petroleum accepted the bid on August 2, 1927, or within about two months from date of filing. The concession contract having been signed subsequently, the government's legal consulting body, the Council of State, declared the instrument to conform to law of September 15, 1938. This granted Condor up to September 15, 1947, or a maximum period of 9 years, to explore the tract and develop such oil deposits as found to a commercial production stage.

● **Drilling obligation.** Within 2½ years from September 15, 1938, i.e., not later than March 15, 1941, Condor was obliged to have installed and to have spudded its first test. The first test, which proved to be the discovery well, Casabe 1, was spudded on March 12, 1941.

The maximum 9-year period mentioned is divided first into a 3-year period during which time the first test must be spudded, and the rest into yearly periods, which are granted provided the operator has fulfilled all his obligations, particularly the drilling obligation. At least 30 days prior to the lapsing of the 3-year period, for Yondo August 15, 1941, the operator may solicit an additional exploratory year, which, if granted, obliges the operator to spud at least two wells during that additional year. This legal situation reveals that Condor had at the most 5 months to drill the first test and then decide whether it should: (1) Solicit an additional exploratory year and spud two new tests in the tract, or (2) surrender the concession. This decision had to be made yearly during the exploratory 9-year period granted.

● **Exploration.** To October 20, 1940, when construction of the road to Casabe 1 began or just about two years after the contract was approved, the tract was the object of intense exploratory activity, which included aerial mapping, surface geological work and geophysical studies, both gravity meter and seismograph work. The cost of these technical studies, necessary for locating the first test, which proved to be the discovery well, was in excess of $500,000. It is significant that the Casabe field is the first field discovered in Colombia by means



Alfonso López, President of Colombia, throwing in the clutch connecting the 90 hp. diesel with pumps initiating formally the 30-year exploitation period for the Yondó concession. To the right of the President are J. A. Gutierrez, general manager of Condor and H. S. M. Burns, general manager of Shell in Colombia.

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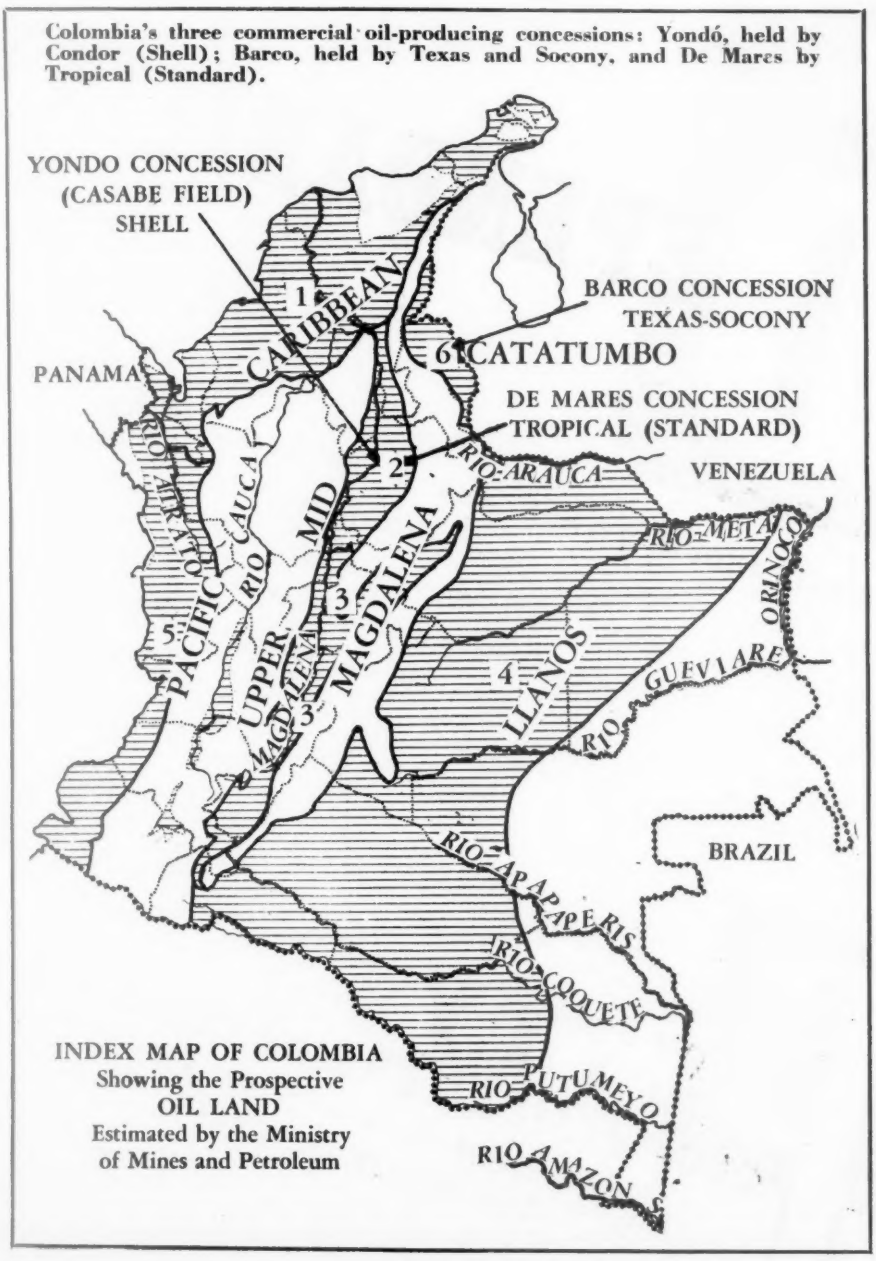
of geophysical studies. The other producing fields in the De Mares and Barco concessions were discovered on the basis of natural seepages. The Casabe discovery undoubtedly is a remarkable technical achievement. A considerable outlay, however, had to precede the spudding of the discovery well.

● **First test.** The road to Casabe 1 from the Magdalena River portsite was finished on January 22, 1941, or after 3 months' work. Estimated cost of building the road in this swampy land is placed at Ps. 10,000 per kilometer or US $9200 per mile. Construction of foundations was begun upon completion of the road and finished on February 5. Assembly of the derrick required 14 days and rigging up was not completed until the spudding date, March 12, 1941. From road construction to spudding date, 143 days elapsed. Due to the swampy nature of the ground, piles had to be driven to support the foundation.

Comfortable mess hall for workmen at Yondó concession—the Casabe field.



Colombia's three commercial oil-producing concessions: Yondó, held by Condor (Shell); Barco, held by Texas and Socony, and De Mares by Tropical (Standard).

● **Drilling.** The discovery well, Casabe 1, was completed on October 20, 1941. Total depth is 2500 m. (8200 ft.) This depth was reached on August 22, or in 163 days of drilling. This gives an overall rate of 50 ft. of drilling and coring a day. Testing operations consumed the rest of the period to October 20, or approximately two months. The well was completed as a producer for 456 bbl. of 22.0-deg. API crude oil.

● **Casing program.** Casing program for Casabe 1 was as follows: 13⅜-in. surface pipe, 61-lb. set at 1385 ft.; 7-in. 28-lb. set at 6720 ft.; 4¾-in. 16-lb. string set at 7640 ft. At this depth the hole deviated 5½-deg. from vertical. The casing program for Casabe 12, which is a typical program for the field, is as follows: 13⅜-in. 48-lb. set at 332 ft.; 9⅝-in 36-lb. set at 2660 ft.; 6⅝-in. 20-20-lb. liner set at 2620 to 3770 ft. Making use of the weight per ft. and the depth at which the casing was set in Casabe 1, the total weight of the strings are as follows: 13⅜-in., 84,485 lb.; 7-in., 188,160 lb.; 4¾-in., 122,240 lb., which totals 394,885 lb., equal to 176 long tons.

● **Fuel consumption.** As may be noted from Table 1, wells Casabe 2 to 8 were completed during 1942. Fuel consumption during the period these wells were being drilled totaled 23,872 bbl. This gives a unit consumption of 0.96 bbl. of fuel, approximately 1 bbl., per ft. drilled. The total footage of these 7 wells was 25,800. The average depth of the wells was 3780 ft. At Barranca Bermeja, De Mares concession (shown on the accompanying map) the cost of fuel oil No. 5 was Ps. 1.20 per bbl. f.o.b., approximately 70 cents U. S. Economic significance of fuel consumption is apparent.

● **Wells drilled.** Up to June 6, when pipe-line shipments began, 30 wells had been completed in the Casabe field. In addition, Cano Negro, located 6.5 miles from Casabe 1, was drilled to 5420 ft. in the Yondo tract and proved dry. Of the 30 Casabe wells that were completed and tested only one, No. 10, was dry.

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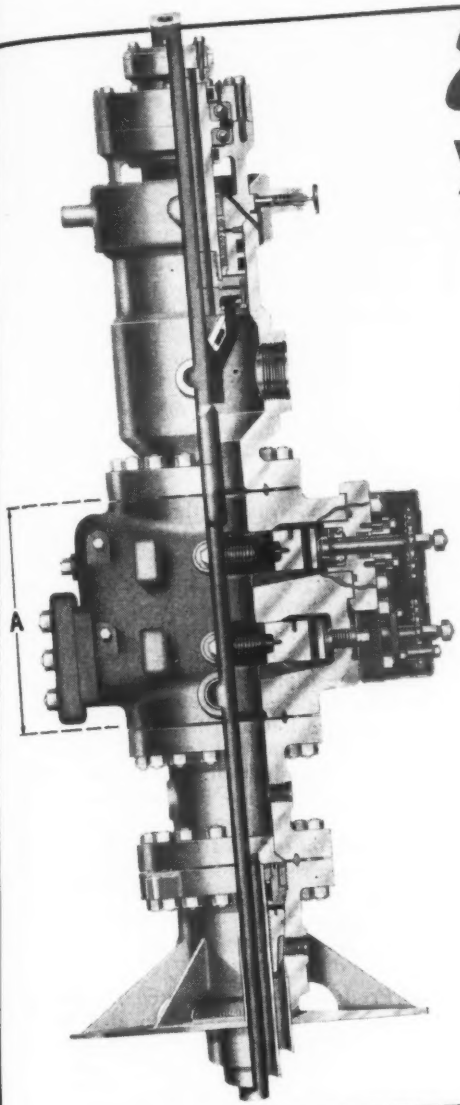

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TABLE 1

Drilling progress in proving Casabe field

No. Casabe wells and year completed		Total depth Meters	Total depth Ft.	Initial 24-hr. production test, bbl.
1941	1	2500	8200	456
1942	2	1110	3640	140
	3	1085	3560	544
	4	1103	3620	214
	5	1100	3610	1230
	6	1220	4000	923
	7	1100	3610	544
	8	1143	3760	692
1943	9	1855	6080	468
	10	2237	7321	Dry
	11	1100	3610	671
	12	1150	3772	468
	13	1150	3772	809
	14	1140	3740	797
1944	15	1262	4150	480
	16	1150	3772	886
	17	1150	3772	780
	18	1150	3772	334
	19	2171	7120	264
	20	1917	6230	400
	21	1150	3772	1100
	22	1150	3772	1200
	23	1150	3772	822
	24	1150	3772	1000
	25	1150	3772	106
	26	1150	3772	900
1945	27	1150	3772	935
	28	1150	3772	200
	29	1150	3772	160
June 6	30	1125	3700	500

Wells completed by years.

Year.....	1941	1942	1943	1944	1945	
No. wells.	1	7	6	12	4	(June 6th)

Casabe total footage up to No. 30 well..... 39,293 meters; 128,831 ft.

Well spacing: 20 hectares, or 49 acres, per well.

API gravity: 20 to 24 deg.

Average initial yield per well: 625 bbl. per 24 hr.

This test was located in the western part of the Casabe field and it proved dry due to a fault running north-south. Details of the drilling are given in Table 1.

● **Well spacing.** Wells are being spaced along a quadrilateral system and 449 meters apart (1473 ft.). This spacing is equal to 20 hectares per well or 49 acres per well. Spacing follows the recommendations of the Petroleum Administration for War of Washington. In the De Mares concession the La Cira field has a well spacing of 8.56 acres per well (3.5 hectares) and other areas 17.5 acres per well (7.1 hectares). The Infantas field has a well spacing of approximately 10 acres (4.05 hectares) per well. As the De Mares fields and Casabe have a similar geological pay, these data indicate that when drilling equipment becomes available and restrictions are lifted the present Casabe field will have more than twice the number of wells for the given area.

TABLE 2

Comparison of oil development experience in Colombia to place a concession in the commercial exploitation stage

		Yondo	Barco	De Mares
1.	Concession	Shell	Texas-Socony	Tropical
2.	Operator	War	Normal	Normal
3.	Business conditions	323	261	335
4.	Pipe line distance inland, miles	1938	1931	1919
5.	Year concession granted	1945	1939	* 1926
6.	Year pipe line shipments began	7	8	7
7.	Time elapsed (No. 5-No. 4), years			
8.	Footage drilled in concession when pipe line shipments began	134,251	105,000	261,109
9.	Number producing wells when pipe line shipments began	28	65	105
10.	Dividing No. 7 by No. 8—footage per producing well	4800	1620	2480
11.	Average initial deliveries, bbl. per day	8000	13,000	27,800
12.	Average gravity of crude, deg. API, initial deliveries	21.5	45	28
13.	Average f.o.b. price 1944 and API gravity of oils, per bbl.	..	$1.54 (45.7 deg.)	$1.04 (24.5 deg.)
14.	Pipe line tariff to seaboard plus loading charge, per bbl., cents	28.6	40.5	28.6
15.	Average daily export during 1944, bbl.	8450 (June-July)	12,500	49,500

● **Footage drilled.** Total footage drilled in the concession was 134,251 up to June 6, pipe-line delivery day. In the Casabe field it was 128,831 ft., or an average of 4280 ft. per well.

As may be seen from data of Table 2, for the De Mares concession the total footage when pipe-line shipments began in 1926 amounted to 261,109, there having been completed 105 producers. This is an average of 2480 ft. per producing well, much less than for Casabe operations. In the Barco concession, the total when pipe-line shipments began, was 105,000 ft. drilled to complete 65 producers, which averages 1620 ft. a well. These data serve as indices in appreciating the additional drilling cost to develop the Casabe field as represented in the light of the other two oil concessions in the country.

Workmen's quarters at Yondó.

The footage per day for Casabe drilling varies from 37 ft. to 222 ft. for Nos. 1 and 13, respectively. From March 12, 1941, when Casabe 1 was spudded, to April 24, 1944, when No. 18 was completed, 918 days elapsed. Total footage in the Yondo block, amounting to 83,221, gives an overall average of 90.5 ft. a well per day of drilling and coring. This compares with an average of 30 ft. a day for some 31 wildcats drilled in Colombia since 1937.

● **Potential.** Totaling the initial 24-hour flow potential, the producing wells have a potential of slightly more than 10,000 bbl. a day, of flush production. This potential may be compared to actual pipe-line deliveries for De Mares and Barco concessions during the first 6 months of shipments. De Mares averaged during this time 27,800 bbl. a day, whereas the Petrolea field of the Barco averaged 13,000 bbl. per day. Casabe crude oil production, which was 8000 bbl. a day on June 6, has increased to as much as 10,000 bbl. a day. With an average crude oil output from De Mares and Barco concessions of 57,000 bbl. a day for the first five months of 1945, the 10,000 bbl. a day from Casabe represents a 17.6 per cent increase in Colombia's average daily output.

● **Producing zones.** In the De Mares the two producing fields, located 20 k. SE 45-deg. from Casabe have 3 oil producing zones, A, B, and C. Gravity of crude from zone A is about 20.5-deg. API, similar to Casabe crude. Zone A has a thickness of about 1000 ft., similar to Casabe pay, which also is about 1000 ft. Zone B is also present in the Casabe field. In the De Mares concession the B pay varies between 1050 and 1300 ft. in thickness. Zone C has been reached in the Casabe field by No. 1 test. The C zone in the Casabe field produced a 23-deg. API oil comparable to De Mares crude from the same zone. These sands, which are lenticular, are all Tertiary of Upper Oligocene and Middle Oligocene age. The Casabe C zone is at a depth of about 6000 ft.

The pipe-line tariff for Casabe has been established by the Government as follows: Connecting line, 6 miles to Andian common carrier: 5 centavos per bbl.; Andian common carrier 317 miles haul to Mamonal: 47 centavos per bbl.; loading charge 3 centavos; total, 55 centavos or 31.4 cents U.S. per bbl.★ ★ ★

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*Based on actual case records in our files.

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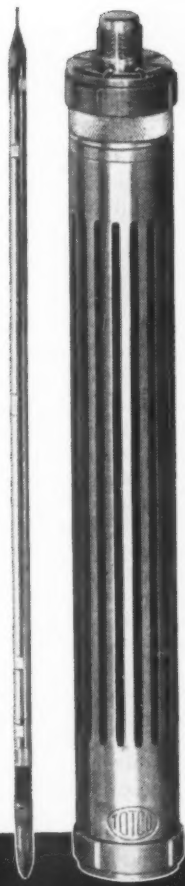

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Oil for America's Future

By **ROBERT E. WILSON,** *Chairman of the Board*
Standard Oil Company (Indiana)

The accompanying article is a digest of testimony presented October 3, 1945, before a special committee investigating petroleum resources of which Senator Joseph O'Mahoney was chairman. Inasmuch as the status of reserves in the United States will play a vital role in the world oil picture by becoming a factor in international petroleum trade, the presentation of this information in The Petroleum Engineer's Foreign Number is pertinent.

ALTHOUGH it includes only about 7 per cent of the world's land area and 7 per cent of the world's population, America has for many years been producing and using more than two-thirds of the world's petroleum and the world's motor vehicles, and consuming more than one-half of the world's rubber supply. All three of these are a measure of our outstanding position as a nation on wheels, and of the essentiality of our need for a plentiful supply of quality petroleum products at reasonable prices. Our per capita consumption of oil is 30 times the average of the rest of the world.

● **War record outstanding.** In spite of repeated and widely circulated "scare stories" during the last 25 years, predicting an imminent shortage of oil, the American petroleum industry, operating as a free and highly competitive industry, has never failed to meet all essential requirements. Even when confronted with the stupendous problem of meeting a military and essential civilian demand for petroleum products that reached a peak of about 5,500,000 bbl. per day, and in spite of shortages of transportation, materials, and manpower and of crude prices fixed at levels below average replacement costs, the industry has done the job. To do so, it increased its domestic production and refining by about 1,100,000 bbl. per day as compared with 1941. Military and lend-lease demand increased about 1,500,000 bbl. per day during the period and overall civilian consumption had to be cut about 400,000 bbl. per day. Widespread public objections to rationing, especially before the necessity became well understood, provide some measure of our nation's reliance on adequate petroleum supplies and emphasize the importance of their availability.

To aid in understanding the amazing magnitude of the petroleum industry's accomplishment in meeting war demands, consider these facts: America has supplied aviation gasoline at a daily rate *more than a hundred times* as much as at the peak of World War I; and motor gasoline at nearly a twenty-fold rate, yet this demand has been met with field crude prices and refinery gasoline prices roughly half what they were 25 years ago!

● **Long-range forecast difficult.** The proper period of forecast for presentation to this committee has been the subject of considerable discussion by our industry Committee on Petroleum Requirements.* Obviously we can be much more certain of the outlook for the next 5 or 10 years than we can for the more distant future. On the other hand, we feel that we should attempt to forecast at least 20 years ahead, because policies to be established now should certainly take into account developments that seem likely to occur within a generation.

Although the petroleum industry has supreme confidence in its ability to meet every demand for petroleum and its products for many, many years, it is understandably reluctant to try to forecast definite detailed figures for two or three decades ahead. Seldom, if ever, has our industry been bold enough to forecast for many years ahead the extent of expansion of either the demand for petroleum or the ability of the industry to supply that demand from domestic sources. The unfortunate experience of our sober and highly regarded U. S. Geological Survey makes any group reluctant to undertake projections except with many reservations. In 1918 the Survey estimated the total crude reserves underlying the country to be around 6,500,000,000 bbl. and most contemporary geologists were inclined to concur. Actually we have since that time produced 25 billion barrels and have today proved producible reserves of more than 20 billion barrels, a total already seven times that estimated by the Survey.

● **Industry confident, provided**—We approach our present forecasting problem in much the same spirit as a well-educated young man about to marry. He does not know for whom he will be working or how much he will earn or just what his financial requirements will be, but he has supreme confidence that, given his health, he will be able to make a good living and give adequate support and protection to his family, though at what precise level the balance will be struck he cannot predict. The only important "if" in his mind is the question of *continued health* and *freedom of opportunity*—and that is exactly the feeling of the petroleum industry as it looks ahead into the future. Given a continuation of a legal and economic climate conducive to free competition in discovery, research, development, and distribution, the industry knows a dozen ways in which any possible demand can be met, even though it cannot predict just which of these methods will prove most efficient and economically desirable when the time comes.

● **Supply and demand outlook.** The supply and demand picture presented by Mr. Coleman and others for the next 20 years may be summarized as follows:

(1) The Eastern Hemisphere has more than adequate crude supplies for, and is logically located to supply, the entire Eastern Hemisphere demand so far as volume is concerned. Roughly speaking, the Eastern Hemisphere has slightly more than half the world's proved reserves with less than a quarter of the world's prospective demand. Although products of unusual quality, as well as various specialties, will probably continue to be exported from the Western Hemisphere, after the next few years such exports will not be of substantial importance in striking a Western Hemisphere balance—indeed the balance of flow may some day be in the other direction.

(2) If Eastern Hemisphere crude production does come to supply most of Eastern Hemisphere needs—and this will most certainly be the general trend over the coming years—there will be a large surplus of crude in South America available for shipment to the United States and Canada. Without this large South American production, shipped

(Continued on Page 171)

*Robert E. Wilson, chairman; Joseph E. Pogue, Chase National Bank; Stewart P. Coleman, Standard Oil Company (New Jersey); J. French Robinson, American Gas Association; H. J. Struth, Texas Mid-Continent Oil and Gas Association; James V. Brown, Independent Petroleum Association of America; E. Buddrus, Independent Natural Gas Association; Earl E. Wagy, Standard Oil Company of California; Fred Van Covern, American Petroleum Institute.

(Continued from Page 166)

both to the United States and direct to the fighting fronts, the war demands could not possibly have been met.

(3) With the end of the war the total United States demand, especially for gasoline, has dropped rather sharply from wartime levels. Except for possible continuing strike difficulties in the oil, motor or tire industries, however, the postwar gasoline demand will probably pass its minimum by next spring and the overall demand by next summer with a 1946 average around 1,000,000 bbl. per day below the wartime peak. Thereafter, except for possible temporary slumps in the event of an economic depression, the trend of demand for petroleum products appears to be steadily upward, with particularly rapid gains during the first 3 years. Unless military demand continues as a major factor for several years, however, total domestic demand will probably not exceed the wartime peak of domestic plus military export demand for about 10 years. The postwar rate of increase in demand for gasoline and distillate fuels will probably be somewhat greater than the average, and that for heavy residual fuels somewhat less than the average for all products.

(4) The further we look into the future, the harder it is to estimate accurately the demand for petroleum and its products. The projected demand curve presented in Fig. 1*, instead of being a line, probably ought to be represented as developing into a widening band within which actual demand is likely to fall. Barring a major depression the domestic demand for the period 1961-65 appears likely to be about 750,000 bbl. a day above the 1944 level of domestic plus export demand, or nearly 2,000,000 bbl. per day above 1939 levels.

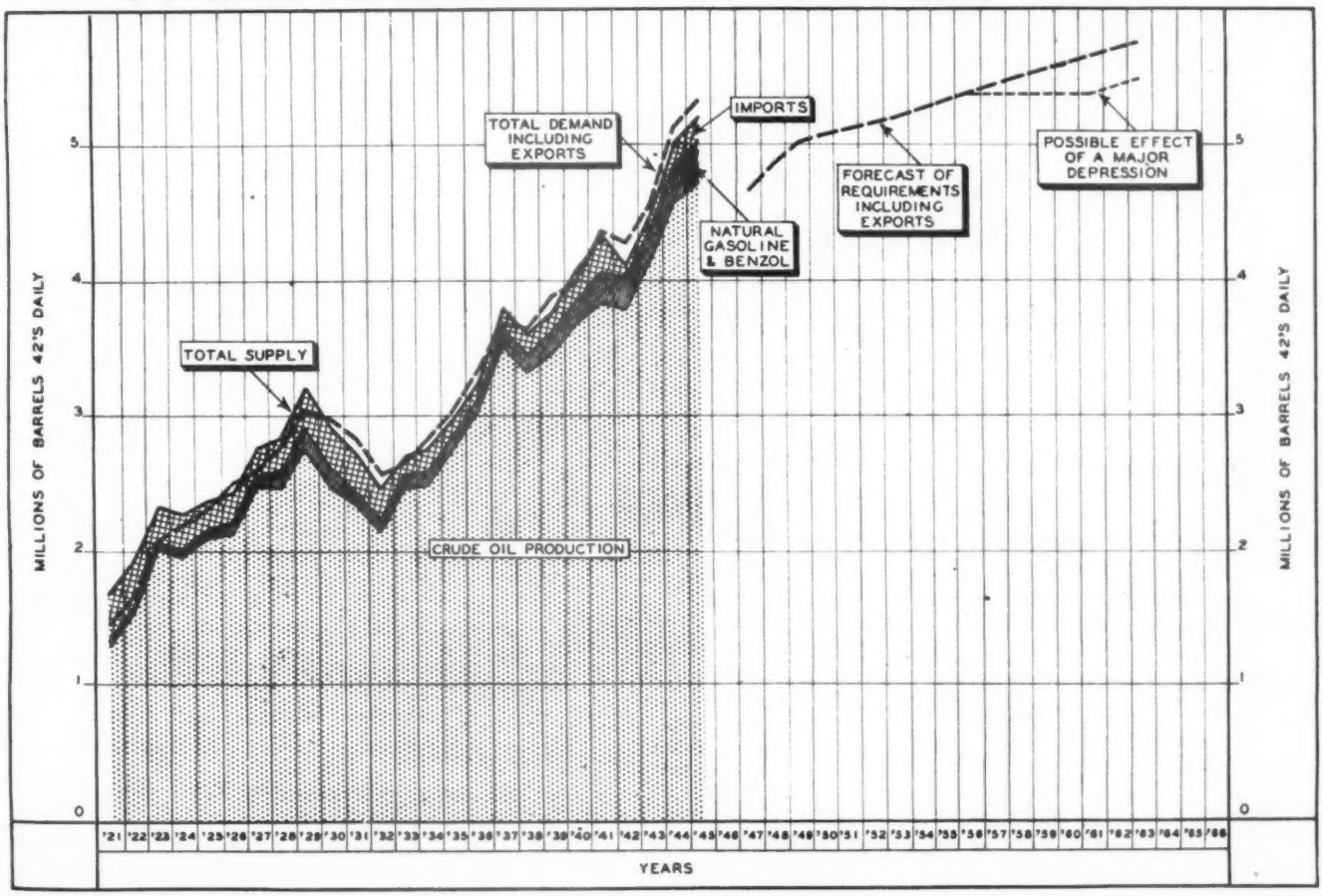
(5) The future rates of production of crude oil in the United States are difficult to predict with accuracy because they will depend on many variables, such as price, good or bad fortune in discovery, the development of new methods of finding oil, government policy regarding taxation and public lands, etc. In general, however, it appears that under favorable conditions for crude production the ability of our domestic industry to produce crude will, probably for the next 5 years—and possibly for the next 10 years—nearly equal the lower range of probable demand and will make possible a substantially self-contained domestic industry, if that should be deemed desirable. On the other hand, under a less favorable combination of conditions affecting domestic crude production there will be an increasing gap between domestic production of crude petroleum and the domestic demand for petroleum products. It is conceivable (though in my opinion not probable) that, under a combination of high demand and low production, this gap between our domestic production and our domestic demand might exceed a million barrels per day during the last 5 years of the 20 years we are considering.

● **Many ways to meet demand.** Assuming such a combination of circumstances, how will the industry meet this difference between a possible adverse domestic crude supply situation and a possible strong domestic demand amounting, as I have indicated, to as much as a million or more barrels per day by 1965? The only *definite* answer I can give is that *I do not know*. But I *do* know that there are many possible ways in which it *can* be met, assuming only the essential freedom and continued health of the petroleum industry. Which method or combination of methods will best meet the deficiency, if it actually appears, will depend upon changing economic conditions and quite probably on new discoveries and technologies of which we do not today even dream, any more than we dreamed 25 years ago that we could make gasoline from coal or natural gas at reasonable costs.

● **Free prices could balance supply and demand.** Before discussing the important technological factors, let us consider some of the more obvious possibilities. In the first place, if it were deemed important that a balance be achieved within this country between domestic supply and domestic demand, the automatic working of the price factor could readily remove the entire discrepancy if allowed to operate freely. Petroleum supply is, over a period of time, highly

*The demand estimates and this figure were prepared by the committee in June on the assumption that the war would end in 1946. In view of the earlier V-J date the whole curve could probably be moved one year to the left, but it seemed unnecessary to reconvene the committee or redraw the curve since my testimony is directed to the more distant future.

U. S. SUPPLY AND DEMAND OF CRUDE OIL AND PETROLEUM PRODUCTS


TOTAL DEMAND INCLUDING EXPORTS
IMPORTS
FORECAST OF REQUIREMENTS INCLUDING EXPORTS
POSSIBLE EFFECT OF A MAJOR DEPRESSION
NATURAL GASOLINE & BENZOL
TOTAL SUPPLY
CRUDE OIL PRODUCTION
MILLIONS OF BARRELS 42'S DAILY
MILLIONS OF BARRELS 42'S DAILY
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YEARS

sensitive to price, because price has a strongly stimulating effect on exploration, wildcat drilling, the development of remote fields, and methods of secondary recovery. The combined effect of these and related factors over a period of a few years can make a tremendous difference in the amount of oil that this country can produce. In addition, any substantial increase in the price of products would have a depressing effect on consumption, especially if the prospect were for a continued, even though moderate, upward trend.

As an example of what would happen in almost every field of petroleum demand, consider the sharp increase in home insulation and other means of reducing fuel oil consumption that has taken place as the result of the wartime shortage of domestic heating oil. In my opinion, a majority of the homes that have burned fuel oil in the past will burn less oil postwar than prewar, because of improvements in home insulation, burner or boiler efficiency, and other factors tending to conserve heat; and such effects would become more prominent if there were to be any substantial increase in the price of heating oils. Although the cleanliness, labor saving, and convenience of oil would prevent any substantial shifting back to coal, any large increase in price undoubtedly would tend to reduce new oil burner installations.

As to gasoline consumption, the immediate effect of an increasing price would probably not be great. Even with our present high gasoline taxes, the cost of gasoline is still only a small part of the cost of operating a car. Mainly for this reason, the much higher efficiency the petroleum industry has built into its gasoline during the last 20 years has not been converted into much increased mileage per gallon, but has gone to meet public demand for larger cars, flashier performance, and higher top speeds. The continuance for any considerable period of substantially higher gasoline prices, however, would undoubtedly have its effect in bringing about more emphasis on economic performance of automobiles. Even without higher prices, the wider use of automatic gear shifts and the probable trend toward lighter and more streamlined cars will have a tendency to convert more of the increased gasoline efficiency into better future economy.

The effects that increasing price and improving technology are likely to have on the production and consumption of heavy fuel oil are complicated, but will serve as an interesting illustration of industry economics. The new processes for catalytic cracking, whose aggregate installed capacity has aready reached 60 per cent of our prewar thermal cracking capacity, characteristically produce more gasoline and distillate fuel, and much less heavy residual fuel oil, than does thermal cracking. These processes will be increasingly adopted as thermal cracking plants wear out, and since they give higher yields of the more valuable products their adoption would be stimulated by rising crude prices. Heavy fuel oil postwar will no longer be a major and inevitable by-product of petroleum refining, forced to find a market in close price competition with coal even in large installations. Its price is therefore likely to go up somewhat more rapidly than that of crude. On the other hand, even without larger imports, adequate supplies would undoubtedly be available for ships' bunkers and for moderate sized installations where oil's efficiency, cleanliness, and labor saving are sufficient to justify a reasonable premium over coal.

● **But at what price?** Although we can be certain that rising prices *could* achieve a balance between domestic production and domestic demand for at least 20 years ahead, we cannot be certain just what price might be necessary to achieve this balance. If the cost of finding oil should increase anything like as rapidly over the next 20 years as it has during the last decade, the increase in price necessary to achieve such a balance might prove to be undesirably large and tend to penalize American industry, shipping, and individual consumers in comparison with the rest of the world. Also, too sharp a reduction in the peacetime production and consumption of heavy fuel oil would be hazardous in view of the vital importance to the Navy of having large quantities of such fuel available in wartime. Again we note that the existence of a vigorous industry with widespread distribution operations is a military necessity.

It seems clear from the foregoing that whereas free prices could assure a balance of domestic supply and demand for at least a generation ahead, the price required to achieve such a balance might well prove excessive, and that alternatives must be considered.

● **Imports could balance demand.** The second obvious way in which a balance can be achieved between supply and demand is, of course, by importation of sufficient and crude and/or products to achieve such a balance. As South America has been exporting to the United States and the Eastern Hemisphere during most of 1945 about 700,000 bbl. per day on the average, and even then drawing on its reserves at a lower percentage rate than the United States has been, there should be no difficulty in importing enough crude, mainly or entirely from Western Hemisphere sources, to meet a possible 1960-65 deficiency of about 1,000,000 bbl. a day. Such partial reliance on sources outside the United States may appear unsafe in view of the possibility of another national emergency. During the early part of the present emergency there were many months when enemy submarine activity made it almost impossible to get oil from South America to the United States. On the other hand, if we have the wisdom to maintain our new Caribbean bases and an adequate Navy, there should be little possibility of any such future debacle. As a matter of fact, any reasonable plan for future national security must consider the protection of the Western Hemisphere as a whole, and of the lines of communication between North and South America, which are essential for so many of our raw materials.

Fortunately, for reasons previously pointed out, most of the imports needed to balance domestic demand and protect possible Naval requirements are likely to consist of heavy fuel oil and heavy crudes, both of which are readily available in South America, and would have a minimum effect on the domestic crude market.

● **Sound import policy essential.** This last point puts a finger on the most serious problem in handling the question of importation. In view of the current low discovery costs, and the very high production per well characteristic of many foreign fields, heavy importation of crude at little or no duty could result in a price depression that would have disastrous results on our domestic producing industry and most of our domestic refining operations. If America is to be strong and ready to meet any emergency, we must keep exploration, wildcatting, and development of new fields at a reasonably high level and must encourage the continued installation of new and better refining equipment in our domestic refineries. It is fortunate that we can, and proper that we should, use imports to make up the difference between domestic demand and our ability to produce at reasonable costs, but such action should not be carried to a point that will ever allow us to become mainly dependent on sources outside the country for our vitally essential supplies of liquid fuel. Furthermore, depressed prices due to unrestricted importation would discourage continued technological advances in the making of petroleum from natural gas, coal, and oil shale, which are likely to be our principal ultimate sources of petroleum products.

To my mind the only sound answer to this difficult problem is an import policy that will permit the needs of industry and individual consumers to be met at reasonable prices, and yet not flood the market or keep prices at a level that would discourage an adequate amount of exploration, wildcatting, and secondary recovery activities in this country. I have shown the vital importance of a healthy domestic industry, and such activities are the best measure of its underlying health.

Developing the details of a sound import policy to accomplish these results will not be a simple task, but the general objectives are so clear that I believe the entire industry as well as the well-

East Indies Oil

Oil wells in the Dutch East Indies should be in production again within 3 to 6 months, according to J. W. B. Everts, an official of the Royal Packet Navigation Company, in a recent interview.

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informed consumers can unite in agreeing to their desirability. The fact that the most probable imports from South America will consist of relatively heavy crude and fuel oil will tend to take care of our most probable shortages with a minimum of repercussion on the domestic industry.

● **Synthetic gasoline from gas.** Increases in price or increases in imports are by no means the only way in which a possible shortage could be met, however. We already know how to make gasoline from natural gas by the new Fischer or Synthol process at costs similar to present costs, and by devoting only one-third of the present proved reserves of natural gas to this type of operation and producing them at a rate of 4 per cent of such reserves per annum, it would be possible to produce about 500,000 bbl. per day of gasoline, or about 30 per cent of our prewar gasoline consumption. Similar processes could alternatively produce high quality diesel fuel and wax, and would yield large amounts of important chemicals as by-products.

● **Other synthetic possibilities.** Beyond the above possibilities, which could, if desired, be put into large-scale operation within the next year, technologists have developed several other processes that can, if necessary, supply our liquid fuel needs for many generations to come. I do not believe these other processes will play any large role for the next few decades, but they are important, both as showing that the industry realizes the importance of maintaining a liquid fuel supply far into the future, and that it has also actually done something about it in the way of research and development.

After the last war, oil shale was the only major reserve to which we could look in the event of possible exhaustion of petroleum. During the last 25 years, however, technology has developed not only the abovementioned methods of making gasoline and diesel fuel from natural gas, but also two processes for making gasoline and other liquid fuels from coal, of which our reserves are virtually inexhaustible.

The first process developed, that of hydrogenation, can be employed to make gasoline from low grade coals on a large scale at refinery cost 10 to 15 cents per gal. above present gasoline costs. It was Germany's mainstay during World War II until our air force really got to work on it.

The other process, the Fischer process as applied to coal, initially appeared to involve costs almost as high as those for hydrogenation, and suffered from the fact that it had to start with high quality coking coal and produced gasoline of poor quality. Both of these drawbacks have been overcome as the result of research during recent years. Given just a few years of further research and development, this Fischer type of process can be operated on sub-bituminous coals and lignites, of which our domestic supplies are enormous, to produce good quality gasoline and diesel fuel at costs not more than 5 or 6 cents per gal. above present costs. This possibility eliminates even a remote danger of petroleum shortage. The gasification step of this process can also make a high quality fuel gas as a substitute for natural gas.

● **Government research program.** Although technologists in Great Britain and Germany have already operated these processes on a commercial basis, considerable research remains to be done to make large-scale operations efficient and economical under American conditions and on American raw materials. As the industry regards this as a very long-range alternative, it is not likely to spend the large sums required for large-scale pilot plants or semi-commercial units. The U. S. Bureau of Mines program of research and development along these lines therefore seems to me to be sound, though the industry opinion on this point is divided. I do urge, however, that the building of semi-commercial units should be postponed until much more research and pilot-plant work has been done. Large semi-commercial units are very expensive and cumbersome to operate and quickly become obsolete as research continues. They should not be built until commercialization of the process appears reasonably imminent.

● **Oil shales and tar sands.** Still other possibilities for the long-range future are oil from oil shale, of which there are large deposits in the western states, and oil from tar sands, of which there are tremendous deposits in Canada. For supplying areas where transportation costs are favorable, both of these may come into use at about the same time the coal processes do, but both the location and the size of the coal and lignite deposits are such as to make them appear to be the most likely major sources of petroleum if and when crude petroleum becomes scarce.

● **Technology may find other sources.** Although our coal deposits could supply us with abundant liquid fuel for more than a thousand years, it is quite possible that even before our petroleum deposits are exhausted, and certainly before we use up much of our coal, still other and cheaper sources of power will be developed. Our technologists have not lost their magic touch. They are hard at work in many fields and no man can tell what the next 25 years will bring forth.

● **Atomic power.** I am glad that this testimony was postponed from last July because I had been officially requested to omit even passing mention of atomic power as one of the technical possibilities for the future. Although its practical application must be preceded by much expensive research and development, and the economics might never justify the building of new plants to make the raw materials for atomic power, it seems quite possible that the next decade may see commercial applications of power development in large units from raw materials made in our present plants. God granting that they be not needed for military purposes. In such large units the necessary control equipment and heavy protective devices to shield the operators from the various radiations could probably be installed without disproportionate cost. I do not believe there is a reasonable probability of atomic power ever being used to run automobiles, though no scientist would say such a thing was impossible, especially after noting the amazing achievements of science during the war.

In any case the possibility of atomic energy becoming an important source of power certainly cannot be disregarded. It is one more reason why we should not insist on a sharply limited use of existing resources when the rapid pace of technical development might conceivably make such resources less needed in the future than they are today.

● **Technology our real reserve.** To summarize, the one point I want to emphasize to this committee is that our most important reserve does not consist of the number of barrels of oil that we can point to in the ground, but rather of research and technology supported by a healthy and vigorous industry. Technology is the indispensable finder, developer, and multiplier of our natural resources, and given a fair chance will accomplish even more in the future than it has in the past. The most essential element of national oil policy is to leave the industry free to develop on a tried and proven basis, and to shun the adoption of measures that would attempt to regiment research, destroy the incentives to invention, or prevent the free play of competitive enterprise. ★ ★ ★

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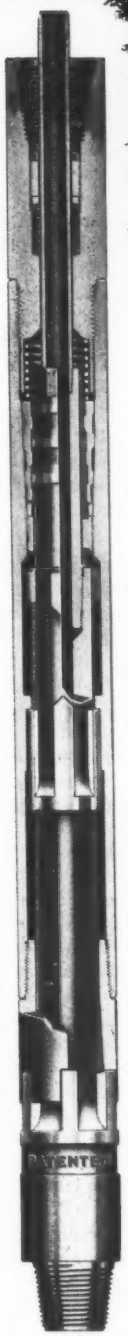

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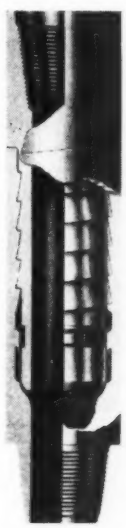

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TEXT OF ANGLO-AMERICAN OIL AGREEMENT

SIGNING of a revised agreement on petroleum between the government of the United Kingdom of Great Britain and Northern Ireland and the government of the United Staates of America was announced simultaneously September 24 in London and Washington. The revised agreement supersedes the Anglo-American agreement on petroleum that was signed in Washington on August 8, 1944, but which was not brought into force.

The delegates who negotiated the new agreement were: For the United Kingdom, the Right Honorable Emanuel Shinwell, Minister of Fuel and Power, in association with Hector McNeil, Parliamentary Undersecretary of State for Foreign Affairs. For the United States, the Honorable Harold L. Ickes, Secretary of the Interior and Petroleum Administrator for War; Ralph K. Davies, Deputy Petroleum Administrator; and Charles B. Rayner, Petroleum Adviser to the State Department.

Shinwell, head of the United Kingdom delegation, and Ickes, head of the United States delegation, signed the new document on behalf of their governments.

Official advisers to the United Kingdom delegation were: Sir Norman Duke, Ministry of Fuel and Power; F. C. Starling, Ministry of Fuel and Power; Sir David Waley, Treasury; R. A. Gallop, Foreign Office; Victor Butler, British Petroleum Representative in Washington; and K. L. Stock, Ministry of Fuel and Power, secretary.

Official advisers to the United States delegation were: Robert Hardwicke, Chief Counsel Petroleum Administration for War; John A. Loftus, Chief of the Petroleum Division Department of State; Gordon M. Sessions, Foreign Relations Assistant to the Petroleum Administrator for War; Samuel Botsford, Petroleum Administration for War, recording secretary; Victor Barry, Petroleum Attache American Embassy, London; and James C. Sappington, American Embassy, London.

Preamble: The Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland, whose Nationals hold, to a substantial extent jointly, rights to explore and develop petroleum resources in other countries, recognize:

1. That ample supplies of petroleum, available in international trade to meet increasing market demands, are essential for both the security and economic well-being of nations;

2. That for the foreseeable future the petroleum resources of the world are adequate to assure the availability of such supplies:

3. That the prosperity and security of all nations require the efficient and orderly development of the international petroleum trade;

4. That the orderly development of the international petroleum trade can best be promoted by international agreement among all countries interested in the petroleum trade, whether as producers or consumers.

The two governments have therefore decided, as a preliminary measure to the calling of an international conference to consider the negotiation of a multilateral petroleum agreement, to conclude the following agreement.

Article I:

The signatory governments agree that the international petroleum trade in all its aspects should be conducted in an orderly manner on a worldwide basis with due regard to the considerations set forth in the preamble, and within the framework of applicable laws and concession contracts, to this end and subject always to considerations of military security and to the provisions of such arrangements for the preservation of peace and prevention of aggression as may be in force, the signatory governments affirm the following general principles with respect to the international petroleum trade:

(A) That adequate supplies of petroleum, which shall in this agreement mean crude petroleum and its derivatives, should be accessible in international trade to the nationals of all countries on a competitive and nondiscriminatory basis;

(B) That, in making supplies of petroleum thus accessible in international trade, the interests of producing countries should be safeguarded with a view to their economic advancement.

Article II:

In furtherance of the purposes of this agreement, the signatory governments will so direct their efforts:

(A) That all valid concession contracts and lawfully acquired rights shall be respected and that there shall be no interference directly or indirectly with such contracts or rights;

(B) That with regard to the acquisition of exploration and development rights the principle of equal opportunity shall be respected;

(C) That the exploration for and development of petroleum resources, the construction and operation of refineries and other facilities, and the distribution of petroleum shall not be hampered by restrictions inconsistent with the purposes of this agreement.

Article III:

1. With a view to the wider adoption of the principles embodied in this agreement, the signatory governments agree that as soon as practicable they will propose to the governments of all interested producing and consuming countries the negotiation of an international petroleum agreement which *inter-alia* would establish a permanent international petroleum council.

2. To this end the signatory governments agree to formulate at an early date plans for an international conference to negotiate such a multilateral petroleum agreement. They will consult together and with other interested governments with a view to taking whatever action is necessary to prepare for the proposed conference.

Article IV:

1. Numerous problems of joint immediate interest to the signatory governments with respect to the international petroleum trade should be discussed and resolved on a cooperative interim basis if the general petroleum supply situation is not to deteriorate.

2. With this end in view, the signatory governments agree to establish an international petroleum commission to be composed of six members, three members to be appointed immediately by each government. To enable the commission to maintain close contact with the operations of the petroleum industry, the signatory governments will facilitate full and adequate consultation with their nationals engaged in the petroleum industry.

3. In furtherance of and in accordance with the purposes of this agreement, the commission shall consider problems of mutual interest to the signatory governments and their nationals, and with a view to the equitable disposition of such problems it shall be charged with the following duties and responsibilities:

(A) To study the problems of the international petroleum trade caused by dislocations resulting from war;

(B) To study past and current trends in the international petroleum trade;

(C) To study the effects of changing technology upon the industrial petroleum trade;

(D) To prepare periodic estimates of world demands for petroleum and of the supplies available for meeting the demands, and to report as to means by which such demands and supplies may be correlated so as to further the efficient and orderly conduct of the international petroleum trade;

(E) To make such additional reports as may be appropriate for achieving the purposes of this agreement and for the broader general understanding of the problems of the international petroleum trade.

4. The Commission shall have power to regulate its procedure and shall establish such organizations as may be necessary to carry out its functions under the agreement. The expenses of the commission shall be shared equally by the signatory governments.

Article V:

The signatory governments agree:

(A) That they will seek to obtain the collaboration of the governments of other producing and consuming countries for the realization of the purposes of this agreement, and to consult with such governments in connection with activities of the Commission.

(B) That they will assist in making available to the Commission such information as may be required for the discharge of its functions.

Article VI:

The signatory governments agree:

(A) That the reports of the Commission shall be published unless in any particular case either government decides otherwise;

(B) That no provision in this agreement shall be construed to require either government to act upon any report or proposal made by the Commission, or to require the nationals of either government to comply with any report or proposal made by the Commission, whether or not the report or proposal is approved by that government.

Article VII:

The signatory governments agree:

(A) That the general purpose of this agreement is to facilitate the orderly development of the international petroleum trade, and that no provision in this agreement, with the exception of Article II, is to be construed as applying to the operation of the domestic petroleum industry within the country of either government.

(B) That nothing in this agreement shall be construed as impairing or modifying any law or regulation, or the right to enact any law or regulation, relating to the importation of petroleum into the country of either government.

(C) That, for the purposes of this article, the word "country" shall mean:

(1) In relation to the Government of the United Kingdom of Great Britain and Northern Ireland, the United Kingdom, all British colonies, overseas territories, protectorates, protected states, and all mandated territories administered by that government and

(2) In relation to the Government of the United States of America, the continental United States and all territory under the jurisdiction of the United States, lists of which, as of the date of this agreement, have been exchanged.

Article VIII:

This agreement shall enter into force upon a date to be agreed upon after each government shall have notified the other of its readiness to bring the agreement into force and shall continue in force until three months after notice of termination has been given by either government or until it is superseded by the international petroleum agreement contemplated in Article III. ★ ★ ★

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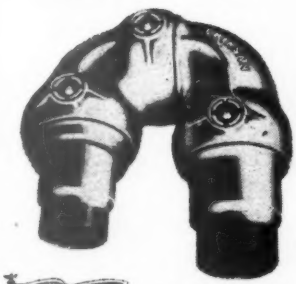

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By **MARTIN J. GAVIN**

Assistant Director, Foreign Refining Division, Petroleum Administration for War; Member, American Production Mission to China

EXCLUSIVE

ONE result of the Japanese invasion of the coastal provinces of China and capture of their ports was the discovery and development of the first commercial oilfield of the Chinese Republic.

With the western ports through which petroleum products were formerly imported in the hands of the enemy, the National Resources Commission of the Ministry of Economic Affairs of the Chinese Government in 1938 established a small organization to prospect for petroleum in Kansu Province. The site chosen for test drilling was on the floor of a river gorge near the crest of anticlinal structure, not far from several active oil seepages that have been known for centuries. In fact, the small river that cuts across the structure has been known for more than 2000 years as the Shihyouho ("rock-oil river"). The first well, spudded in during February, 1939, was soon completed as a pumper at a shallow depth in the upper or "K" sand. During the next two years, several additional small pumping producers were completed in this sand, but the results did not warrant much enthusiasm for future prospects. Early in 1941, however, a well drilled into the second or "L" sand at about 1450 ft., came in flowing out of control and established the field as one of considerable importance. As a result, in March, 1941, the Kansu Petroleum Production and Refining Administration was formally organized in Chungking, with Mr. Y. C. Sun as general manager, and steps immediately were taken for exploitation of the now-proved field.

The field, termed the Yumen oil field in most previous reports, has been officially designated the Laochunmiao field by the Administration. It is situated in the foothill zone within the Kansu "Corridor" on the northern slope of the Nanshan or Chilienshan range of mountains. The surface altitude of the present producing wells ranges from about 8000 to 8300 ft. above sea level. The field is not far south of the historic Old Silk Road between Russia and China, where the road traverses the "gobi" plain between the cities of Chiuchuan and Yumen.

The field has been developed and exploited in the face of tremendous difficulties and the accomplishments to date testify to the perseverance, ingenuity, and abilities of the Chinese technical and business men, which overcame seemingly impossible tasks. Once the potentialities of the field were known, equipment for drilling, production, refining, and transportation were ordered from the United States, but comparatively little had arrived in China, via the Burma Road, when the occupation of Burma closed the road and resulted in capture or loss of material en route. With the equipment that did arrive and with other equipment and material available and manufactured in China, and despite the long highway haul from importation and manufacturing points to the field, development has progressed steadily. Since 1942 there has been a very small flow of supplies over the "hump" from India. This was increasing steadily in the months immediately before the Japanese surrender, but was far from adequate to meet requirements for a well-balanced operation.

Because of inadequate materials and equipment and inexperience with high-pressure production, several of the first wells drilled into the "L" sand were not good completions or came in and remained uncontrolled for considerable periods of time. Later as experience was gained with the assistance of a few American drillers and a production expert, as a certain amount of heavy duty equipment was brought to the field and as better mud materials and cement were made available, completions were generally successful and at the time the field was visited by the writer in March,

1945, all producing wells were flowing under control through flow beans. In general, production has been limited by the availability of transportation facilities to move products to points of consumption.

The crude oil is of intermediate base, approximately 32.5-deg. API, 50°F. pour point, and 0.15 per cent sulfur. No gas separators have yet been delivered to the field, hence gas is separated from the oil in brick separating tanks at atmospheric pressure and there are no gas recovery facilities either on the separators or on the flow or storage tanks. The high pour point of the oil coupled with the average low atmospheric temperature at the field not only causes difficulties by wax depositing in well tubing but requires that tanks be steam heated and gathering system and transportation lines to the refinery be steam traced. Shortage of pipe and fittings for the gathering system evidently has resulted in wells being more closely spaced than good production practice would dictate.

All wells are drilled by the rotary method, using diesel-powered equipment.

Refining

The crude oil is refined in a pipe still unit, supplemented with several small shell still batteries. The pipe still is made up partly of material brought in from the United States before the closing of the Burma Road—a part of the material incidentally originally destined for a combination topping and cracking plant but diverted to its present use after the closing of the road—and partly obtained in China. Many of the pumps, valves, and fittings are of Chinese manufacture and much of the pipe is salvaged material. The shell stills were made in China from salvaged steel plate as were many of the boilers supplying steam to the refinery and field. No cracking facilities have yet been installed, consequently only straight-run gasoline is made, the yield of which is about 21 per cent. Other fractionated products are kerosine, gas oil (produced primarily as a source of paraffin), and wax. Part of the wax is made into candles in the field, the rest is shipped in cakes to Chungking to another candle factory also operated by KPRRA. Candle making machinery was made in China. Residual fuel oil, which contains much of the gas oil, the lubricating oil fractions and excellent asphalt is discarded to waste, for there are yet no facilities for the recovery of products from it, and because of transportation limitations, no available market. It is used, however, for refinery and field fuel and as heating oil for the Administration's field buildings and employes' dwellings.

A remarkable feature of the establishment is the number and kind of facilities provided for company employes and their families. There are two levels of schools, flour mill, commissary, theater, hospital, bakery, etc. There are several apartment buildings for company employes and more are being erected, replacing the original primitive semi-cave homes. A diesel engine powered generating plant supplies power for field and refinery and lights for buildings and premises. Both common and fire brick are made in the field. The population in the settlement is large by American standards for the scale of operations but most of the work is done by manual labor—there are no bulldozers, ditching machines, power cranes, and such modern power tools as we usually associate with petroleum operations. All these main and auxiliary facilities have been established in a high arid desert country with materials brought in by truck, wagon, cart, and camel caravan from points hundreds of miles away. Cement is brought by truck from Chungking, more than 1400 miles distant by roads that are far from being boulevards. Much of the food has to be brought from places several hundred miles away.

Aside from the continued difficulties of operating with limited transportation facilities in a remote area, the ingenuity of the Chinese engineers commands high respect. The following are a few ex-

A drilling rig in the field and, right, a goatskin raft with drummed gasoline from the refinery on the Chialing River, Chungking.

VERSATILE GRAVITY METER

These actual photographs of a North American Geophysical Co. Gravity meter field party, show the North American Gravity Meter being used in a semi-tropical area. In areas accessible to automobile, the Gravity Meter is normally mounted in a passenger car. At locations where readings are desired, the tripod is extended through the floor of the car and a Gravity reading obtained in less than two minutes.

The North American Gravity Meter can be removed from the car in a few minutes and transported on a back-pack, in a boat, or horseback, in a jeep or by any other local means of transportation. As a result of this versatility, the Gravity Meter can be carried into swamp land, through dense undergrowth, over rugged mountain country and any other terrain with ease and simplicity.

The Meter weighs only 28 pounds. With back-pack and battery the weight is but 45 pounds. The meter is temperature compensated. The current required is sufficiently low, so that a single motorcycle battery will keep the meter unaffected by outside temperature throughout the day.

Manufactured in our own laboratories, the North American Gravity Meter is leased for domestic and foreign operation.

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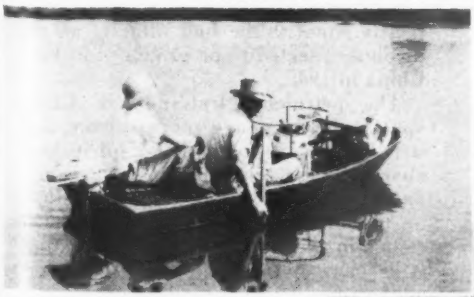
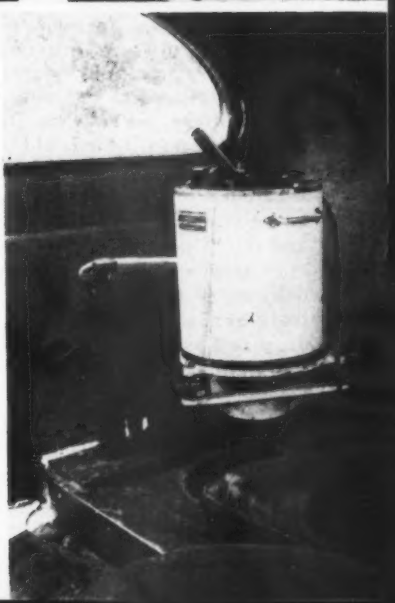
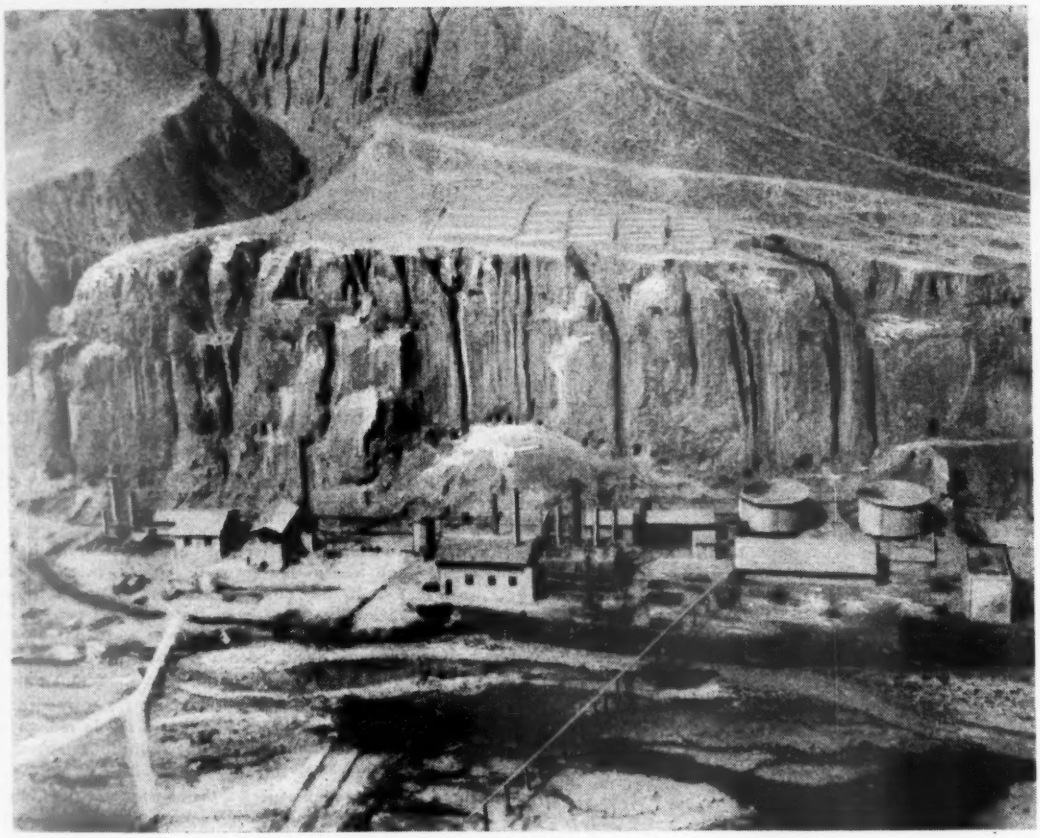
With the North American Gravity Meter in the back pack the crewman sets off for a location in swamp lands.



Two men in a small boat with outboard motor carry the North American Gravity Meter across a lake to make readings on islands or at off-shore locations.

In areas accessible by automobile, the North American Gravity Meter is conveniently mounted in a standard passenger car. With the tripod extended through the floor of the car, it is not necessary to remove the meter to make the reading.





West Refinery, pipe still on left, Laochunmiao oil field.

amples: Smoke stacks are made from oil drums with the heads cut out and the resulting cylinders welded together; if required these are insulated inside. A new crude oil delivery line from field storage to refinery was being constructed from boiler tubes salvaged from a cargo that was sunk in the Yangtze River near Chungking. Incidentally this is a welded line and the quality and workmanship of the welds are excellent. The supply of ¾-in. valves for steam heating and tracing lines ran short and the writer witnessed in the field shops the manufacture as a replenishment of excellent appearing globe valves from material cast from copper and brass coins. The machine tools used in this work were old and needed constant repair; in normal times they would likely have been scrapped years ago but they could not be replaced until transportation into and in China could be improved.

Except for bulk paraffin and finished candles all products are shipped from the refinery in drums by trucks or by animal-drawn carts, the latter mostly for local delivery. KPPRA has its own fleet of trucks, now rather old and maintained as well as possible in the Administration's repair shops despite the extremely scanty supply of maintenance and repair parts. Certain large consumers—agencies of the government—take delivery of products at the refinery in their own trucks. KPPRA has a well-organized system of service stations and overnight hostels for trucks and crews on the transportation route from the field to Kunming via Chungking. Only a relatively small part of the refinery production is delivered as far south as Chungking but materials and supplies have to be hauled from the over-the-hump delivery point at Kunming and much other material originates at Kunming and Chungking.

Transportation

Truck transportation to Chungking is augmented by the use of large rafts on which drummed gasoline is floated down the Chialing River from a point on the highway near the headwaters of barge navigation of that river. These rafts are elaborations of the small goatskin rafts that have been used on the Yellow and other rivers for centuries. The small rafts are buoyed by from 10 to 18 inflated goatskins, whereas the "gasoline" rafts each are supported by some 300 skins. Over the skins is built a timber framework that supports the drums. A fleet of three such rafts carrying some 8000 gal. of gasoline arrived in Chungking while the writer was in that city in April of this year. After the drums have been unloaded, the timber structure is disassembled and sold in the local market while the goatskins are deflated, returned to headwaters, and are used in the construction of new rafts.

The production of the Laochunmiao oil field is still small but during the war it has been of great importance. Except for fuel brought to China over the hump by air and more recently by the CBI pipe line—used entirely by the fighting forces—Free China has had to depend principally on alcohol for a motor fuel. This has been augmented to a small extent by gasoline substitutes made from vegetable oils and to a considerable and increasing extent, particularly in the northern regions remote from alcohol producing centers, by the gasoline produced at Laochunmiao. The Kansu kerosine and candles have been of great value in war-torn China.

Future Prospects

Undoubtedly Laochunmiao is not the only oil field to be discovered in the geologically favorable Kansu Corridor and Lanchow Basin. It is likely that the existing field and fields yet to be discovered will be of prime importance in China's future economy. Laochunmiao is a pioneering achievement and reflects great credit to the organization that undertook it. Planning in which the writer participated, based on increasing "hump" air transport and the opening of the Stilwell Road augmenting material deliveries, reasonably anticipated that had the war continued the annual output of motor fuel from Laochunmiao beginning in another 18 months would have been sufficient to deliver to consuming centers gasoline of fuel value nearly equal to the fuel value of all the alcohol expected to be produced in Free China in 1945.

The petroleum fraternity of China speaks the language of petroleum and acts with the indefinable spirit that characterizes "oil men." It becomes apparent more and more that, regardless of nationality, exposure to petroleum etches in the human being a mark that is as characteristic as the derrick that marks the oil well. China is an honored and welcome new member of the petroleum producing nations of the world.

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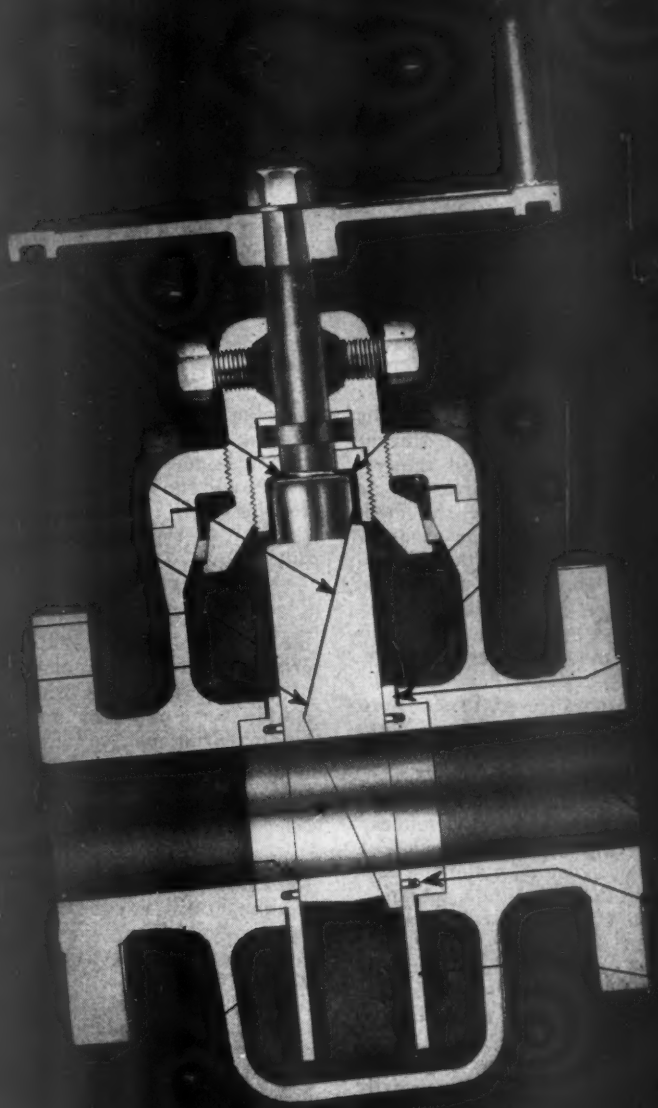
The W-K-M THROUGH-CONDUIT PIPELINE VALVE



Features and Advantages of the W-K-M Steel Pipeline Gate Valve

1. When valve is full open, through-conduit provides an unobstructed passage through valve. This eliminates damaging effect of churning or turbulence when valve is handling abrasive-laden fluids at high-pressures and velocities.

2. When valve is either open or closed, seats are entirely sealed off — pressure tight. This feature insures long-lived seats entirely protected against abrasion, cutting, rust or corrosion.

3. When valve is full open, gate is drawn into upper body where it is surrounded by a mass of grease which protects it against rust or corrosion.

4. Through-conduit eliminates accumulation of foreign matter in the body or gate-cavity of the valve. This insures positive and perfect seal-off when gate is closed.

5. Should gravel, trash, splinters or other foreign matter collect in through-conduit while valve is cracked, such foreign matter is carried down with and held in the conduit when gate is closed. Under no conditions can such foreign matter prevent positive closing of valve. When valve is again opened, foreign matter washes out of valve.

6. Double wedge construction of gate insures positive seal-off on both seats, in either open or closed position.

7. When valve is either open or closed, there is no pressure in the body or bonnet.

8. Freedom from pressure in body or bonnet while valve is in open or closed position permits replacing of packing while valve is in service and under pressure.

9. Freedom from pressure in body or bonnet while valve is in open or closed position permits removal of bonnet, stem and stem guide for replacement while valve is in service and under full-rated pressure.

10. This is the only lubricated gate valve made which uses the body of the valve as a lubricating housing for the working parts, insuring thorough and positive lubrication over a period of years without replenishing.

11. Freedom from internal corrosion because of constant lubrication, by grease with which body is packed.

12. Great ease of operation under pressure, and freedom from excessive friction because of constant lubrication of working parts, and also because seat area is greater than area of gate exposed to pressure.

13. Parallel seats insure positive closure on both sides at any temperature.

14. Gates expand uniformly under high temperature, thus eliminating chance of galling or seizing.

15. Combination wipe-and-seal ring, which is kept constantly in contact with gate, keeps seats and gates free from deposits, cleaning at every operation of the valve.

16. Freedom from leaks around stem or bonnet due to lack of pressure against packing or gaskets when valve is open or closed.

17. Safety in case of fire, since there is no pressure in body of valve in either open or closed position. Stem packing could be entirely burned out without affecting tightness of valve in these positions.

18. Quadruple seal against leaks through stem or bonnet when valve is open or closed as compared to single seal on conventional types of valves.

19. Sextuple seal against leaks through valve as compared to single protection provided by conventional types of valves. The W-K-M Valve has three separate seats on each side, and seals off on all six seats in either the open or closed position.

20. Renewable seats reduce maintenance cost to a minimum. Gates may be refaced five or six times before replacement becomes necessary.

21. Less radial clearance is necessary for installing screw end type.

22. In pipe line work, through-conduit permits cleaning of line with valve in place.

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WAR CONTRIBUTION OF CARIBBEAN REFINERIES

WITH the entry into the war of the United States after the Pearl Harbor attack, full integration of all refinery activities in the Caribbean area became necessary in order to achieve the maximum output of essential war products and to control production of those petroleum products of civilian significance only, consumption of which was held below normal level by the acute situation that arose as regards tanker tonnage. For the purpose of the integration of refinery operations, committees were formed in both London and New York, representative of refinery managements, which acted in an advisory capacity to the refineries in the area and as a channel for the dissemination to the refinery managements of the plans and wishes of the government agencies, under the auspices of which the committees operated. Throughout the period of the war refinery operations were thus geared to the war effort and carried out in accordance with the over-riding military plans of the United States and British governments. The rate of refinery crude throughputs, the division of output between critical war requirements and less critical civilian products, the addition of new facilities designed to increase production of critical war products—all were governed by military policies as expressed through appropriate government agencies, with which the oil industry cooperated.

Within this framework, it is interesting to trace the developments that have taken place with regard to the operations of each of the refineries in the Caribbean area of the Royal-Dutch Shell group, which operates four refineries in this area, with a total present-day daily throughput capacity of over 330,000 bbl. This figure was exceeded during the closing days of the war as a result of the group's efforts to meet the accelerated requirements of the Allied fighting forces.

Prior to the outbreak of the European war in 1939 these refineries had operated mainly on low gravity crudes from Venezuela and Trinidad and had concentrated on production of fuel oils, mainly of the high viscosity type, with the attendant production of less considerable amounts of the other conventional products, such as motor gasoline, naphthas, and kerosines. With the advent of war the requirements from these refineries changed rapidly, with a progressive accent being given to the maximization of the production of high octane aviation gasolines, high octane motor gasolines for the Allied ground forces, thin combat fuels and diesel oils for the Allied navies and the high quality tractor fuels for the vastly increased agricultural activities undertaken in the United Kingdom.

Curacao Refinery

First put into operation 27 years ago, the Curacao Refinery, at Curacao, Netherlands West Indies, ranks today as one of the largest in the world. It produces a wide range of petroleum products, including aviation gasolines, motor gasolines, kerosines, diesel oils, gasolines, fuel oils, lubricating oils, solvents, asphalts, and naphthenic acids.

The storage and tanker loading facilities are at Emmastad, Caracas Bay and Bullen Bay. Drydocks and ship repair equipment are situated at Koningsplein on Schottegat Bay.

Manufacturing facilities at Curacao include crude oil topping, sharp fractionation equipment for recovery of isopentane and butanes from straight run gasoline, and high vacuum distillation of reduced crude oil for lube oil manufacture. A large percentage of reduced crude oil is thermal cracked and heavy straight run naphtha is reformed in conventional thermal reforming plants. The cracked and reformed gasolines are acid treated, redistilled and finished in doctor treating facilities. The cracked gases after separation are processed in UOP selective polymerization, isomerization, alkylation, and cumene manufacturing facilities. Curacao is also equipped with drum and can manufacturing facilities.

The entire Curacao refinery with its tanker loading, storage, and all other facilities, was placed at the disposal of the United Nations for their war needs.

In addition to the production throughout the war years of substantial quantities of 87-octane aviation gasoline, the production of 100-octane aviation gasoline at Curacao Refinery has been increased from zero at the outbreak of war to a level of from 11,000 to 12,000 bbl. a day during the months immediately preceding V-J Day. This increase in the output of a highly critical munition of war has been achieved not only by the addition of specialized auxiliary refinery equipment to the Curacao Refinery but by the application of three new processes, invented and developed in the laboratories of the Royal-Dutch Shell group organization.

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Full integration of refinery activities in Caribbean area was necessary to achieve maximum output of war products.

The first of these is the Avaro process, which was the first successful thermal cracking process developed for the manufacture of an aviation blending agent. The importance of the development of this process was that it was carried out in existing reforming units and therefore needed the addition of no specified equipment during a time when the various contributors to the war effort competed keenly for the available supply of construction materials. The process results in the production from a crude naphtha cut of a highly aromatic aviation blending agent permitting a reduction in the total alkylate content of the 100-octane aviation blend and the incorporation of lower octane base stocks. As the limitation on the production of 100-octane aviation gasoline was generally the supply of light alkylates, the importance of this process will readily be appreciated and, in fact, it generally resulted in a production of 100-octane aviation gasoline disproportionately larger than the quantity of blending agent incorporated.

The second innovation was a combination of new construction and a new process—the erection of a plant for the synthesis of the high octane gasoline blending agent, cumene. This plant was the first to be operated using sulphuric acid as a catalyst.

The third development was in the realm of alkylation and consisted of the alkylation of the light pentane-amylene fractions from cracking and reforming operations, which made possible the subsequent recovery in the limited capacity available of the entire isopentane content for inclusion in the 100-octane aviation gasoline blend.

Of an apparently less critical nature, but of considerable fundamental importance, was the supply of tractor fuel to the United Kingdom. The necessity of obtaining optimum food production in the United Kingdom called for a large increase in the use of tractors. These tractors in many cases had to be handled by inexperienced operators and this factor necessitated the supply of high quality tractor fuel that would permit, as far as possible, trouble-free operations. Such a high quality fuel was not readily available in the large quantities required and for a time practically the entire United Kingdom requirements were provided from Curacao Refinery, the output being allowed to diminish only when alternative sources of supply could be developed.

Another major munition of war that Curacao was called upon to supply in

large quantities was fuel oil of the low viscosity combat type for the Allied navies. The growing demand for this type of fuel in place of the conventional high viscosity residues from Venezuelan crudes necessitated the adoption of refining methods radically affecting the normal operations of the refinery. The importance attached to the output of maximum distillate products already had dictated the incorporation into the crude stream of a greater proportion of high gravity crudes. An ancillary effect was the production of appreciable quantities of low viscosity residues from such crudes. Every effort was made, and with considerable success, to develop and expand the Royal Dutch Shell group's own light crude resources, and, in addition, important quantities of light crudes were acquired from other producing companies for transport to Curacao and incorporation in the refinery throughput. This measure, however, was not adequate to provide the large quantities of thin fuels required and recourse was made to the expedient of asphalt dumping, not only to allow the production of the light products from the crude without excess production of heavy residual fuels, but also to provide the essential quantities of diluent for the lowering of the viscosities of the heavy residues to the desired viscosity of combat fuels. This process of asphalt dumping consists of the vacuum distillation of heavy cracked residues, the recovered distillates here being utilized for the manufacture of diesel oils, and for fuel thinning. The hard asphalt is discarded. This process, during the years of war, was applied to the extent of a total discard of some 11,000,000 bbl. of hard asphalt.

By means of all the measures taken the deliveries of thin combat fuels from Curacao approached the unprecedented volume, when considering one refinery, of 5,000,000 bbl. monthly in the closing days of the Pacific war—a remarkable performance for a single refinery.

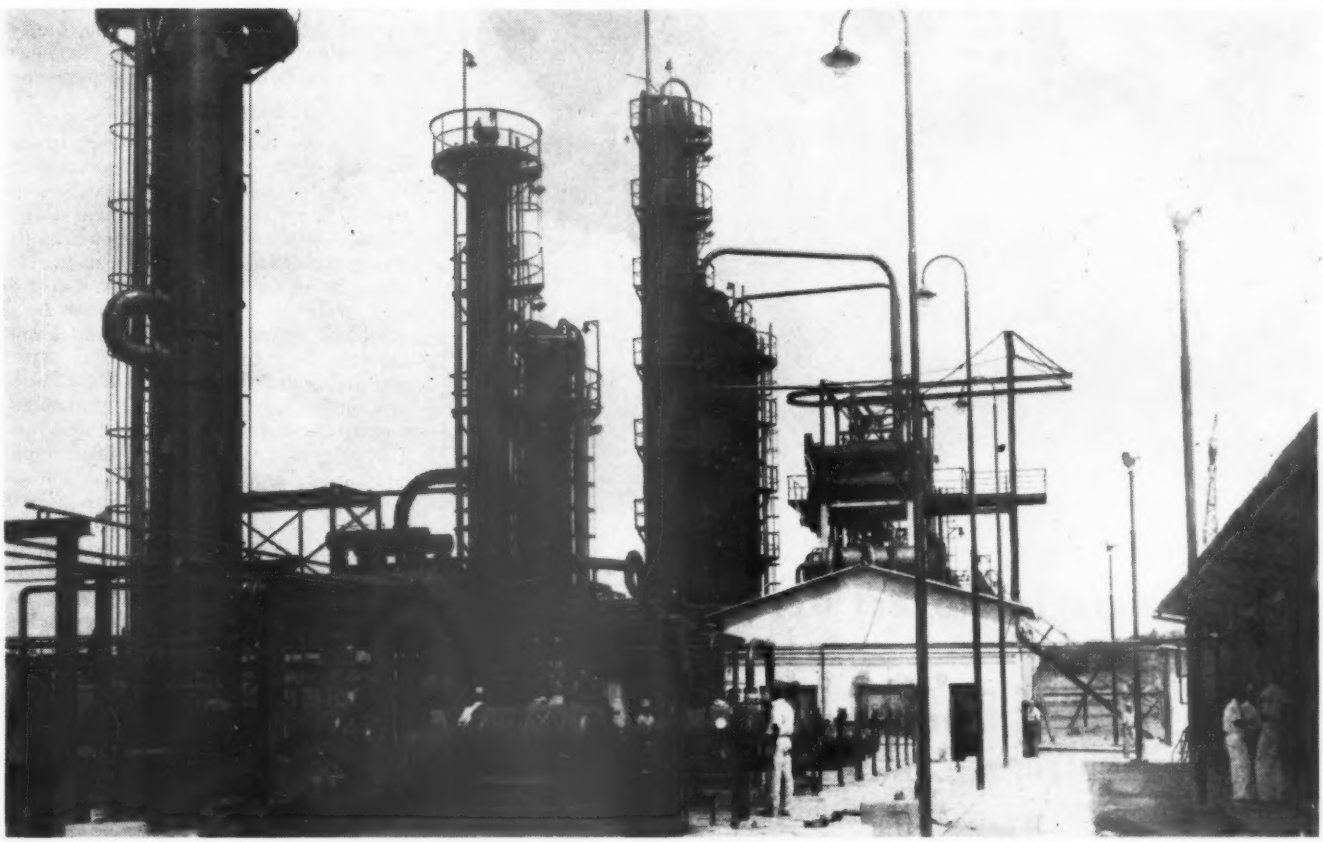
Attending these major activities of the refinery has been the ancillary production of subsidiary products in the form of naphthenic oil residues and reduced petroleum ashes of high vanadium content. Substantial quantities of naphthenic oil residues have been extracted from the kerosine and gas oil fractions and made available for war industries. A particularly important application of this product is as a base for the highly efficient rot-proofing material for wood and canvas, utilized in the manufacture of service equipment, particularly where designed for use under the extreme conditions of humidity in the far Eastern war zone.

As regards vanadium, its presence in small proportions in fuel oils of Venezuelan origin has long been known; however, since vanadium is a metal used in the hardening and toughening of steel required for high-speed cutting tools, armored warships and tanks, the manufacture of guns, motor vehicles and locomotives, forgings and springs, its production became critical with the advent of the war. A process has been increasingly developed by the Royal Dutch Shell group for the greater recovery of vanadium as a wartime measure, through the collection of deposits from oil-fired boiler plants, refinery furnaces, and ships. In the five years from 1940 to 1944 the Shell group's contribution of vanadium recovery from fuel residues totaled 323 tons of vanadium, making possible the production of some 85,000 tons of special steel.

Apart from the change in the emphasis on certain products of critical war importance, the demands of war have necessitated a constantly increasing level of crude oil throughput. Normally, by good operating practice, the plant is geared to run at about 230,000 bbl. per day. As a result of pressure arising from the urgently increasing demands of the Allied war machine, the throughput was raised to about 280,000 bbl. This essential increase in throughput was made possible only by careful study of the operation of each individual distillation unit, increasing allowable throughput by the recovery from the crude of only the lower boiling fractions useful in the manufacture of aviation and motor gasolines while leaving in the residues, for incorporation in combat fuels, the necessary diluent.

The increase in crude oil throughput has been effected despite the inevitable strain of wartime operations notably, with regard to depleted personnel, and has undoubtedly constituted a considerable burden on the personnel remaining

Cumene plant, designed for liquid-phase process using sulphuric acid as catalyst. Said to be only one of its kind in the world.



and responsible for operations. Not only has there been a large increase in throughput but the critical shortage of ocean-going tanker tonnage has necessitated constant preoccupation with the fastest possible turnaround of ships either discharging crude oil or loading out products. Furthermore, with the increased movement of crude oil from Lake Maracaibo, there has been a considerable strain on the staff and crews of the fleet of shallow draft tankers, designed for the transportation of crude from Lake Maracaibo ports to Caribbean refineries, resulting from the necessity for operating in accordance with accelerated schedules to make the most effective use of the limited transportation capacity available.

Despite all these difficulties and the mounting strain of continued operations at peak level, the history of Curacao's operations during the war years has been one of the ever-increasing endeavor and achievement, characterized by the record level of operations achieved in the closing days of hostilities when all resources were being mobilized to the limit to bring maximum pressure to bear upon the foe in the Pacific.

San Lorenzo Refinery

The San Lorenzo Refinery at Lake Maracaibo normally is operated principally for local market requirements, any surplus products being exported. In 1939, before the outbreak of the European war, the average intake of this refinery was 19,200 bbl. a day. Progressively, during the war years it was found necessary to put into effect all unused refinery capacity in the Caribbean to meet the expanded product demand and in step with this need the throughput of the San Lorenzo refinery was increased to full capacity of about 38,000 bbl. a day.

Arend Refinery

In 1939 the average intake of the Arend refinery, Aruba Island, was about 5000 bbl. a day. At the end of 1942, in the light of circumstances then prevailing and in the overall interest of the Caribbean refinery operations, the plant was shut down and remained so until March, 1945. At this stage product requirements of the United Nations had changed to the extent that they demanded the reopening of the refinery, which then operated on an increasing throughput.

Trinidad Refinery

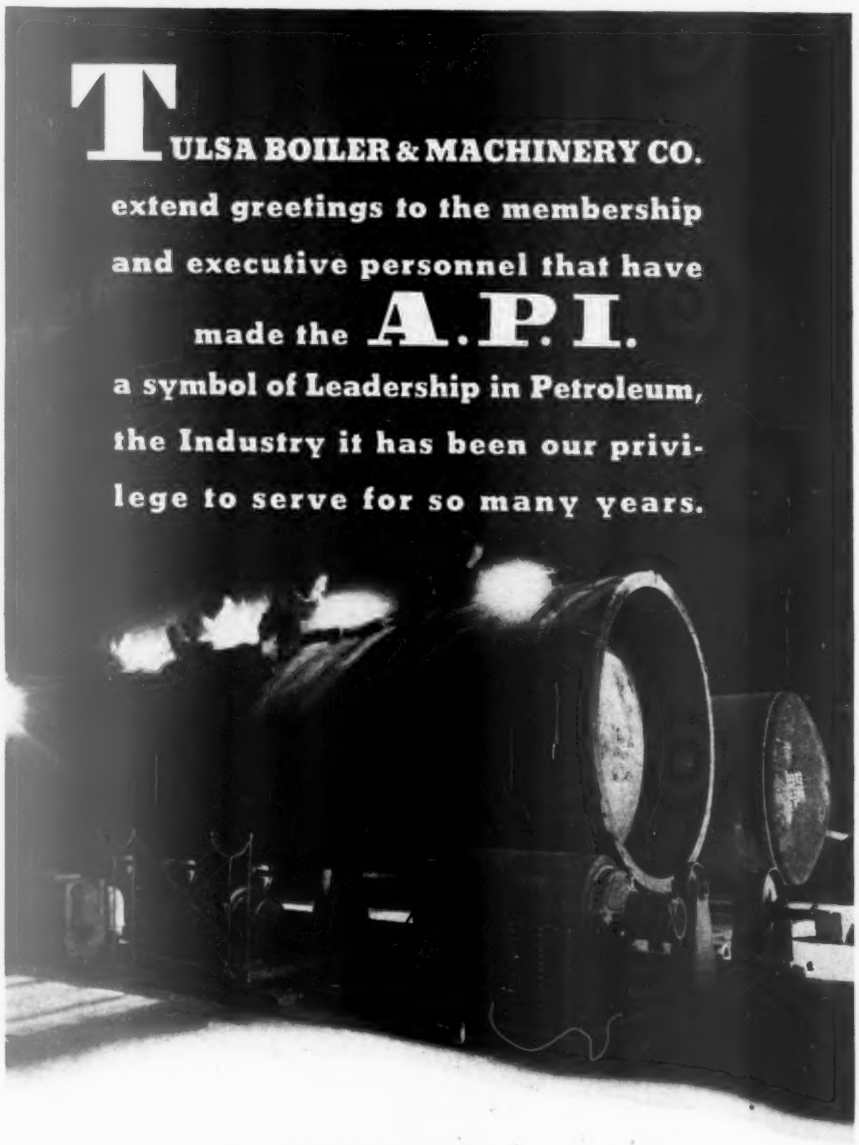
The refinery of United British Oilfields of Trinidad, in Fortin, Trinidad, has been operating throughout the war period at maximum capacity within the framework of the overall United Nations' program of requirements. Refinery runs increased from 18,500 bbl. a day in 1939 to 25,000 bbl. Modifications were made to one distillation unit in order that asphalt for export and the requirements of the United States Naval Base in the Trinidad area could be manufactured. A rearrangement of the plant was made to facilitate the manufacture of the vitally needed war product, napthenic oil residue, production of which has varied between 50 and 70 tons monthly.

A feature of the wartime operations of the Trinidad refinery has been the enormously increased volume of bunker deliveries, which has thrown a heavy burden on both facilities and personnel.

Future Plans

The principal future refinery expansion planned in the Caribbean area by the Royal-Dutch Shell group is the erection of a refinery at a site near Punta Cardon in the southwestern part of the Paraguana Peninsula of Venezuela. The plant, to be built at an estimated cost of well over Bs. 150,000,000, will be a complete refinery, with a throughput capacity in excess of 40,000 bbl. a day and ample cracking and auxiliary facilities, including provision for the manufacture of aviation gasoline and lube oils. The refinery will have adequate terminal and loading facilities, housing accommodation for employes, hospital, sports ground, etc. Certain preliminary survey work already has been undertaken at the site, and work on temporary camp facilities, etc., is already under way.

Although everything possible is being done to expedite the construction of the refinery, the present-day materials situation is the controlling factor, and it is recognized that considerable time necessarily must elapse before materials become available, not only for construction of the refinery plant proper but also for its auxiliary facilities. ★ ★ ★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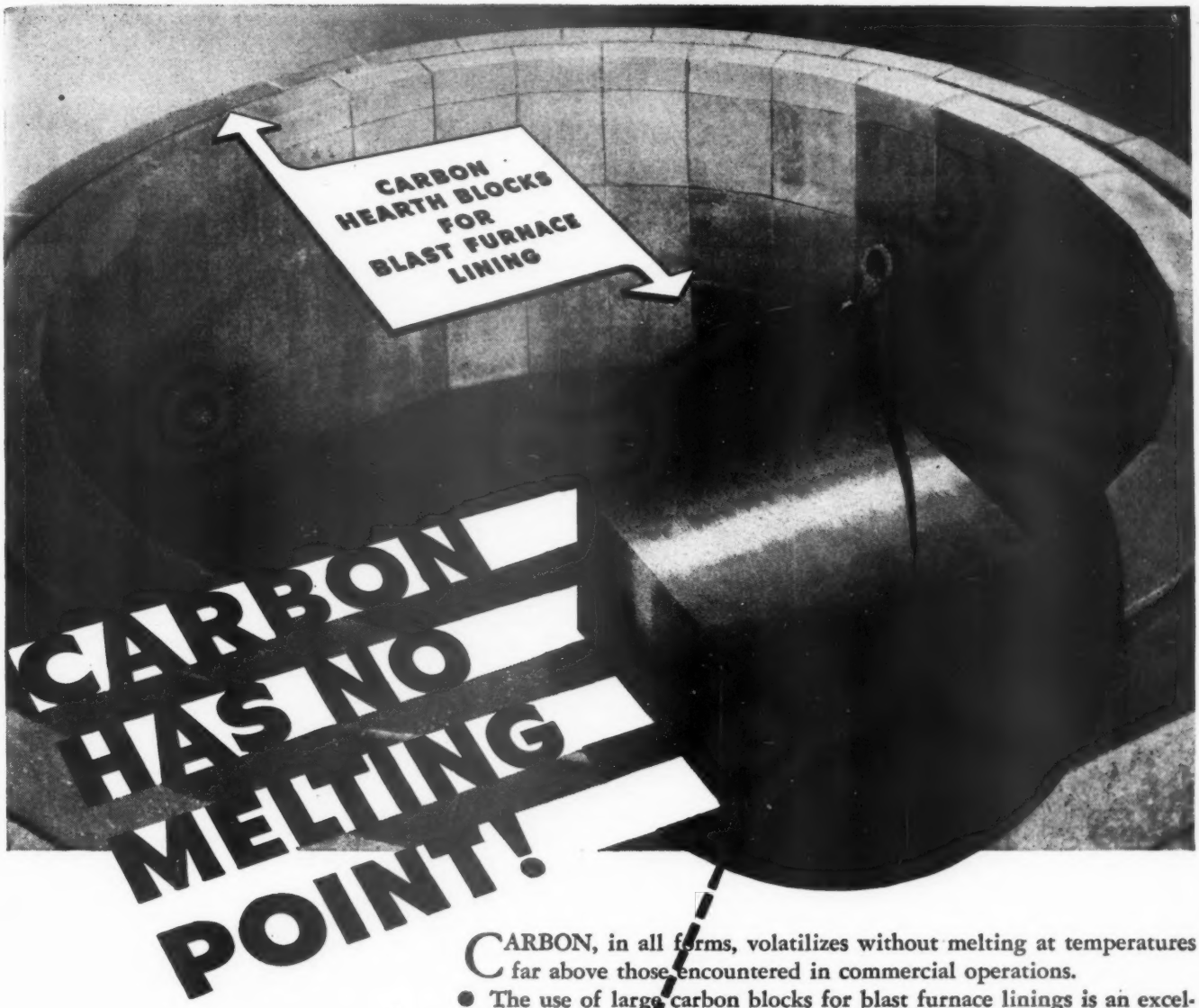

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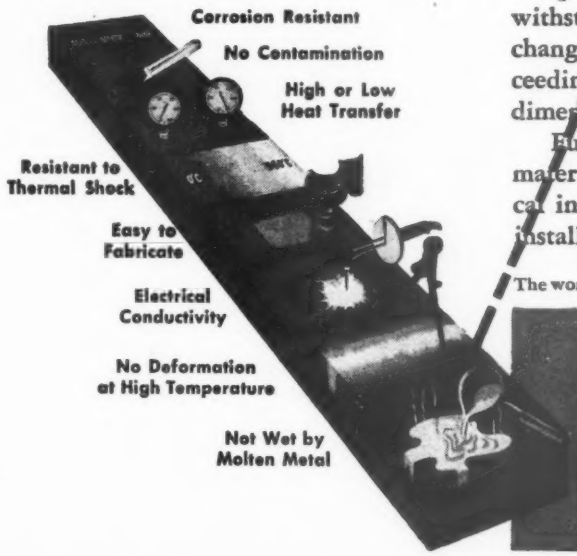

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SOCONY-VACUUM'S EUROPEAN REFINERIES

By **D. L. HOOKER**
Manufacturing Committee
Socony-Vacuum Oil Company

PRIOR to the outbreak of World War II in Europe, Socony-Vacuum Oil Company, Inc., through its European companies, operated 11 refineries and 2 compounding plants in continental Europe, and 2 compounding plants in England. The geographical distribution of these plants is, as follows:

EXCLUSIVE

France: 1 refinery at Frontignan, 1 refinery at Gravenchon, and 1 compounding plant at Rouen.

Italy: 1 refinery at Naples, and 1 compounding plant at Vado.

Germany: 1 refinery at Bremen and 1 refinery at Schulau.

Prewar Poland: 1 refinery at Dziediece.

Czechoslovakia: 1 refinery at Kolin.

Austria: 1 refinery at Kagran.

Hungary: 1 refinery at Almas Fuzito.

Romania: 1 refinery at Brasov.

Yugoslavia: 1 refinery at Bröd.

England: 1 compounding plant at Wandsworth and 1 at Birkenhead.

Officials of Socony-Vacuum have visited the company's refineries in European countries in the American, British, and French zones of occupation to survey, at first hand, the damage inflicted, and to ascertain the cause thereof. Although company officials have not, as yet, been able to visit the refineries in the Balkans, and the refinery at Dziediece in prewar Poland, word has been received of the damage done to these refineries.

It is still much too early to give a detailed report on the extent of the damage to individual refineries, as to obtain such specific data will require considerable time.

At the start of the war it was believed that a refinery could not stand up under air attack, that aerial bombardment would cause complete destruction. Certain of these refineries were subjected to repeated bombing attacks, and although they were knocked off stream none was completely destroyed and, time and again, German repair crews were able to move in and place the refineries back on stream for at least partial production.

The fact that aerial bombardment was incapable of completely destroying a refinery was first indicated by reconnaissance photos and intelligence received after bombing missions, and the fact that greater damage was inflicted by other means was confirmed by inspection and investigation after the close of the war. Damage was inflicted by the following means:

1. *Destruction by enemy demolition crews.*
2. *Dismantling of refinery units by the enemy for removal from original sites to distant points.*
3. *Artillery bombardment. (At least as damaging as aerial bombardment).*
4. *Destruction by order of local authorities.*

Bremen and Schulau

Prior to the war, the Bremen refinery received its crude from Reitbrook, Nienhagen, and Oberg. Unfinished stocks from Bremen were sent to the Schulau refinery for finishing.

The Bremen refinery consisted of the following: One 2600-bbl. 2-stage atmospheric and vacuum pipe still for crude, one 1000-bbl. vacuum pipe still for rerunning, one 1860-bbl. Duo-Sol 2-stage extraction unit, one 975-bbl. B. A. dewaxing plant, a contact filtering, naphtha treating, refined oil treating, and batch-type lubricating oil treating units.

The Schulau refinery consisted of the following units: Neutral oil treating, wax distillate pressing, wax sweating, contact filtering, grease manufacturing, sulphurizing, and used oil regenerating plants.

The Bremen refinery was subjected to numerous air attacks, but, except for damage to the Duo-Sol plant and some damage to concrete work, its principal units are intact. This may be due to the fact that the refinery was camouflaged very effectively and the reported fact that a simulated plant was erected not far from the refinery.

It is interesting to note that the Germans were unable to get much production from the Bremen refinery during the war due to lack of crude supply. So effective was the bombing of transportation facilities in and around Bremen that the Germans were unable to bring in crude even though the source was but 20 miles away.

As to the Schulau refinery, the damage done was considerable, but it can be rehabilitated.

Naples Refinery

Raffineria di Napoli was built by Socony-Vacuum in 1937 at the outskirts of Naples. Prior to the war, its crude was principally received by tanker from the Gulf Coast. Its throughput was about 6000 bbl. per day. Historically it is noted for the fact that it contained the first Houdry catalytic cracking plant ever erected in continental Europe—a 3-case unit of about 2600-bbl.-per-day capacity. In addition it contained the following plants and units: One 4200-bbl. 2-stage atmospheric and vacuum pipe still, two 500-bbl. Dubbs thermal cracking units, one 960-bbl. Duo-Sol solvent extraction unit, one 525-bbl. B. A. solvent dewaxing unit, a naphtha doctor treating unit, naphtha treating and stabilizing units, refined oil treating facilities, wax sweating, treating and filtering facilities, Sharples centrifuge lubricating oil treating units, a contact filtering plant, grease manufacturing equipment, and asphalt plant.

The refinery was sequestered by the Italian government and delivered to AGIP, an Italian state-owned petroleum corporation, in December, 1941, and it has not, as yet, been returned. Although the refinery was sequestered by the Italians, in the latter stages of the war in Italy, it was in German hands.

Differing from the refinery at Bremen, neither the Italians, nor the Germans, did much to protect the refinery against air attack. A number of concrete air raid shelters and a network of trenches for protection of personnel together with earthen dykes thrown up along both sides of the refinery's railroad siding, constituted the protection provided.

On July 11, 1941, before the refinery was sequestered, it received its baptism in war when a munitions train spotted on the railroad siding blew up. The damage to the refinery was slight and was largely confined to broken windows and damaged roofs.

The refinery was subjected to its first aerial bombardment in January, 1943, and the raids continued intermittently through July, 1943. The first substantial damage resulted, however, from a raid in April. A heavy air bombardment occurred on July 15 and this was followed by the largest raid against the refinery 2 days later when 9 successive waves swept over on July 17.

Additional damage resulted from planned destruction by enemy ground forces occupying the refinery. Prior to evacuation, the Germans undertook to insure that the refinery could not be returned to service without extensive repairs. Demolition bombs were used with considerable effect to destroy individual pieces of equipment; however, despite the bombings and the activities of the demolition squads, a great many units at Naples are well worth salvaging.

The compounding plant at Vado, Italy, was also completely destroyed.

Refineries in France

The refinery at Gravenchon received its crude, before the war, by tanker from the Mid-Continent area of the United States, Colombia, and Iraq. Its units consisted of two 3000-bbl. 2-stage atmospheric and vacuum pipe stills, a 3500-

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Drilling a deep oilwell costs about $1,000 a day.

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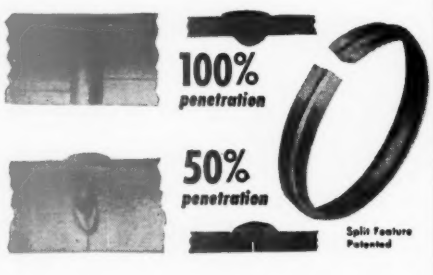

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At the time of the invasion of France by the Germans, all stocks and tanks were burned. The refinery was captured by the Germans, and as the Naples refinery is an example of destruction by demolition crews, Gravenchon is an example of dismantling. With the exception of the thermal cracker, the distillate rerun unit, some few treating facilities, the boilers, generators, and turbines, all other usable units including machine tools, valves, fittings, and instruments were dismantled and moved to presently unknown places in Central Europe.

Temporary repairs are being made and a small amount of crude will probably be processed by January 1, 1946.

The Frontignan refinery crude run was received from East Texas and Iraq. The refinery's units consisted of a 6000-bbl. atmospheric pipe still, a 3500-Cross thermal cracking plant, together with pressure distillate acid treating, pressure distillate rerun, doctor treating, refined oil treating, and liquefied petroleum gas manufacturing facilities.

The Frontignan refinery was intact 3 weeks before the German invasion of southern France after which 89 bombs were dropped on it with severe damage resulting. Temporary repairs have been made and the refinery is now operating on shale oil. As soon as crude is available the refinery will be started up on a topping operation.

The compounding plant at Rouen was virtually destroyed.

Brasov Refinery

The prewar crude run to the Brasov refinery in Romania was enriched Romanian and synthetic Romanian crudes. The refinery's units were a 260-bbl. vacuum pipe still, a 120-bbl. high vacuum shell still, three 700-bbl. shell stills, a 60-bbl. furfural solvent extraction unit, a Coubrough high-vacuum unit, together with DeLaval centrifuge lubricating oil treating, lubricating oil contact filtering, wax distillate treating, wax sweating, wax treating, Sharples centrifuge dewaxing, grease manufacturing, roofing paper manufacturing, and asphalt (pitch) manufacturing facilities.

American Socony-Vacuum officials have not, as yet, visited Brasov, but it is known that what remained of the plant after Allied bombings was dismantled by the Romanians and moved into the mountains. The refinery is now being re-erected on its original site by Socony-Vacuum's Romanian company.

Almas Fuzito

The prewar crude run to the Fuzito refinery in Hungary was enriched Romanian and synthetic Romanian crude. The refinery's units consisted of one 1500-bbl. atmospheric pipe still and naphtha doctor treating, refined oil treating, wax distillate pressing, wax sweating and finishing, batch lubricating oil treating, grease manufacturing, and asphalt manufacturing facilities.

No definite word of the damage to the Fuzito refinery has been received, but it is known that it was heavily bombed. As the refinery was in the line of battle there is reason to suspect that it was demolished by German demolition crews to prevent it from being of use to the Russians.

Kolin

The refinery at Kolin in Czechoslovakia was largely destroyed, but it was built up extensively by the Germans to keep it on stream. No word of its present condition has been received.

The crude run to Kolin was Romanian crude plus enrichments, and enriched Romanian synthetic crude. The refinery's units consisted of one 1800-bbl. 2-stage atmospheric and vacuum pipe still, a 2-unit naphtha rerunning plant for special products, and naphtha doctor treating, naphtha acid treating, refined oil treating, asphalt manufacturing, distillate pressing, wax sweating, treating and filtering, batch lubricating oil treating, lubricating oil contact filtering, and grease manufacturing units.

Brod, Kagran, Dziediece

Socony-Vacuum officials have not, as of this time, had an opportunity to visit the Bröd refinery in Yugoslavia, the Kagran refinery in Austria, or the refinery at Dziediece in prewar Poland, and the extent of the war damage, the causes thereof, and the present condition of the refineries is not now known. There is, however, every reason to believe that each has been heavily damaged.

The prewar units of these refineries included the following:

Bröd: One 2200-bbl. atmospheric pipe still, naphtha rerunning, naphtha treating, refined oil treating, batch lubricating oil treating, lubricating oil filtering, grease manufacturing, and specialties manufacturing plants. Bröd's crude run was Romanian artificial.

Kagran: One 1200-bbl. atmospheric pipe still, refined lubricating oil treating, DeLaval centrifuge lubricating oil treating, contact filtering, and grease manufacturing units. Kagran's crude run was enriched Romanian, synthetic Romanian, and Zistersdorf crudes.

Dziediece: One 1600-bbl. atmospheric pipe still, one 500-bbl. rerun atmospheric pipe still, one 500-bbl. Cross thermal cracking unit, together with a naphtha rerunning unit for close fractionation to obtain special products, and naphtha doctor treating, refined oil treating, wax distillate, sweating and filtering, batch lubricating oil treating, lubricating oil filtering, percolation filtering, Sharples dewaxing, "Kieselgur" filtering, grease manufacturing, and asphalt manufacturing facilities.

British Compounding Plants

The compounding plant at Birkenhead, near Liverpool, was almost completely destroyed by German air raids, whereas Wandsworth, near London, went through the war undamaged. The rebuilding of Birkenhead was started immediately and the plant has long since been returned to service. ★ ★ ★

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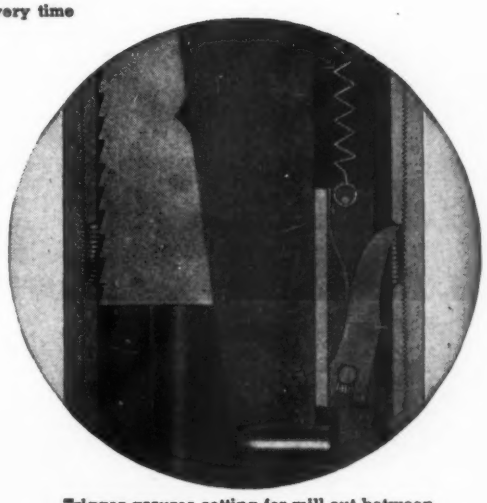


Trigger assures setting for mill-out between couplings.

HORIZONTAL DRILLING—

A means for greater oil recovery

The subject of horizontal drilling in partially depleted fields was discussed in The Petroleum Engineer for August 1944, Page 160.

THE actual area drained by a well drilled through or into a productive sand is problematical. This applies whether the hole is vertical or penetrates the sand at an angle, as when the well is drilled by direction control to reach a predetermined point some distance away from the surface location. The flow of oil to the bore is governed by many natural factors such as permeability and porosity of the sand, the cementation of the grains, the gas content of the fluid and its stratified location, and the driving force moving the oil. Then there are adverse factors tending to retard the flow of fluid into the bore such as infiltration of water from the drilling mud, plastered faces due to use of improper mud, and sloughed sand.

As a well produces, the flow of oil to the bore decreases and movement of fluid from the outer circumference of the assumed drainage area becomes less. Actually the true drainage area probably shrinks as the well produces and much more oil at a distance from the well is left in the sand than is left in the area immediately surrounding the bore. Moreover, additional retarding factors appear, both in the sand itself and at the face of the hole. Among these are fine sand clogging the pores of the sand, sloughing sand in the hole or around the liner, and deposition of colloidal and residual matter from the oil itself.

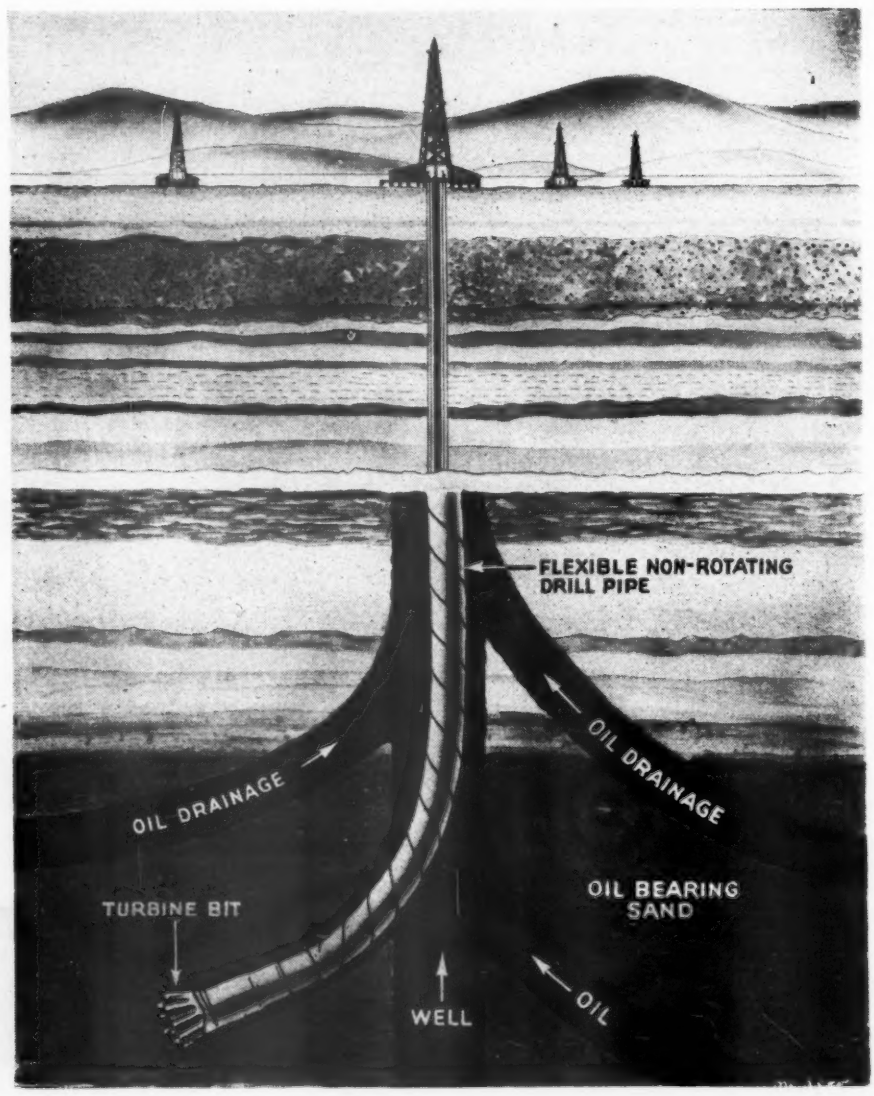
The drilling of horizontal tributary holes from the vertical bore provides a means of increasing the movement of oil from the entire drainage area of a well. Each of these horizontal drain holes establishes an individual drainage area within the assumed drainage of the well and provides a passage for the flow of oil from its drainage area to the vertical hole. Deviating horizontal drilling[1] is therefore applicable to new wells, to old wells for stimulation of production and frequently for production from wells that have fallen below the economic limit, and to wells being produced by secondary recovery methods.

The equipment consists essentially of a turbine bit and flexible drill pipe. The bit is rotated by the drilling fluid, which is circulated by the mud pumps. The mud fluid is maintained at a suitable viscosity for operation of the bit. The drill string is, of course, not rotated during the normal course of drilling the horizontal hole.

One or more horizontal holes may be drilled from the vertical bore, the number being determined by the well conditions and the desire of the operator. As an example, several holes may be drilled radially as shown in Fig. 1. These holes take off from the well in a vertical arc and are located at desired vertical distances above each other. The holes can be started at any point in open hole or through windows cut in liner or casing. The direction of the horizontal holes may by predetermined and the holes started off in any desired direction by orienting the drill string in the well.

The lower part of the drill string used for drilling a horizontal hole consists of the number of joints of flexible drill pipe necessary to carry the hole for the distance from the vertical bore to the point in the sand to which the horizontal hole is to extend. The bottom flexible

FIG. 1



[1]The method of deviating horizontal drilling was devised and the equipment for its use was designed by John A. Zublin of Los Angeles.

FIG. 2

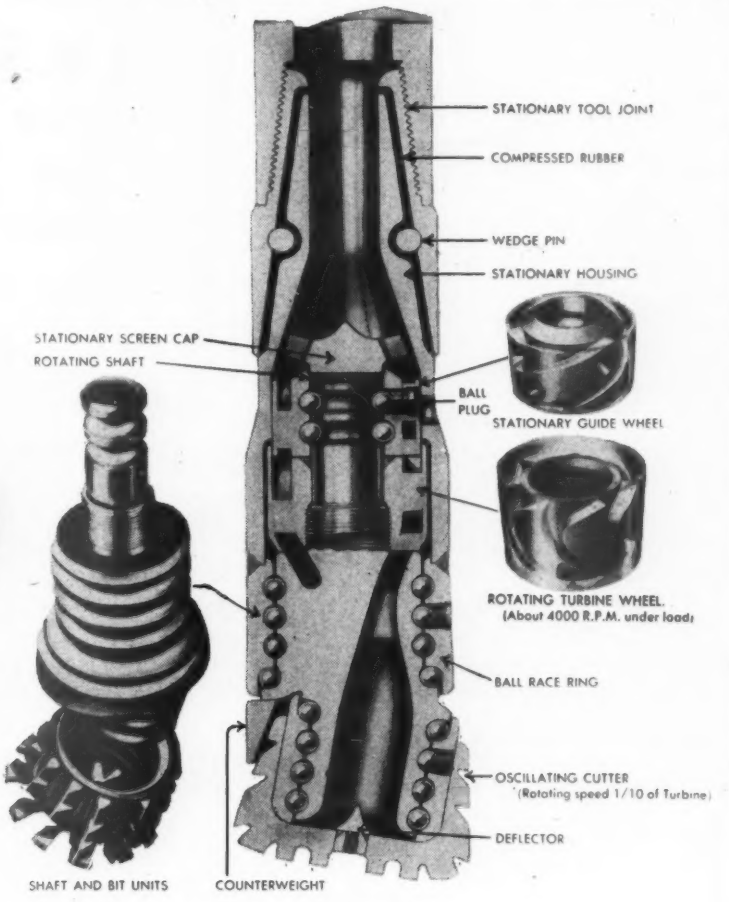


FIG. 3

Elements required to drill an oil well horizontally consist of a straight mandrel to insert in curved flexible drill pipe, which directs the hole away from the vertical hole and the turbine bit actuated by high pressure drilling mud. Details of the bit used in horizontal drilling are shown on the right.

joint to which the bit is attached is made from a curved section of drill pipe. This causes the hole to start off in an arc as the bit begins cutting. The other flexible joints are straight and follow the curved joint along the arc which it establishes. The upper portion of the drill string is made of regular drill pipe.

Flexible Drill Pipe

The flexible joints are made from 4½-in. external flush joint drill pipe as shown in Fig. 2. A spiral slot is cut through the wall of each joint of pipe throughout its entire length except for a distance of 15 in. at each end. The joint is then lined with a high pressure rubber hose, made fluid tight at each end to prevent leakage of the power-circulating fluid. The spiral slot of the straight flexible pipe provides adequate flexibility for the pipe to change from a vertical to a horizontal direction as it passes from the vertical well bore into a curved and then into a horizontal hole. The flexibility of the pipe is indicated in the accompanying illustrations.

The curved flexible joint used at the end of the string and to which the turbine bit is attached is made by cutting a spiral slot in a joint of drill pipe that has been bent to a definite radius and heat-treated to maintain its curved form. Otherwise it is of the same construction as the straight joints of flexible pipe but will tend to return to its original curved form when unflexed. The radii used will usually range from 20 to 35 ft. and it is by selecting the proper radius for the curved joint that any slight upward direction of the horizontal hole can be secured. A 25-ft. radius joint will allow the hole to continue in approximately a horizontal direction after the vertical arc from the bore hole has been drilled since gravity causes the curved joint to straighten out as the bit continues to make hole. Should a slightly upward inclination be desired for production reasons, a curved joint of smaller radius can be used.

Before being run into the well, a mandrel is inserted as a core through the curved section of pipe. See Fig. 2. The curve joint is straightened and held in a straight position by means of a clamping device and the mandrel then inserted. The mandrel is equipped with a spear at the top for the purpose of withdrawing it from the curved flexible pipe. After the flexible pipe has reached its point of operation, the mandrel is withdrawn by means of a sand line. The curved pipe is allowed to assume its curved form within the limits of the hole in which it is confined.

Turbine Bit

The bit used for drilling horizontal holes is a rotary turbine bit which attains a high rotational speed by means of power derived from the energy of the fluid pumped down the drill string to the bit. The construction is shown in the cross-sectional view given in Fig. 3. The cutting action of the bit depends in part upon the tendency of the cutter teeth to lift and drop the bit. A highly efficient bearing mechanism is therefore provided to resist the axial loads imposed by the tendency of the bit to rise and fall and the resistance to such movement by the turbine and the drilling string above. Since turbine parts will eventually be cut away by abrasive action of the power fluid, the construction of the bit provides ready disassembling and reassembling for replacement of parts of the turbine.

The entire bit, including housing, turbine and cutting member is made as short as possible to provide for drilling the curved hole with which the horizontal hole takes off from the vertical. The overall length is only 20 in. The fluid is discharged as close to the cutting teeth as possible in order to remove cuttings from the bottom and to keep the bit and well bore clean.

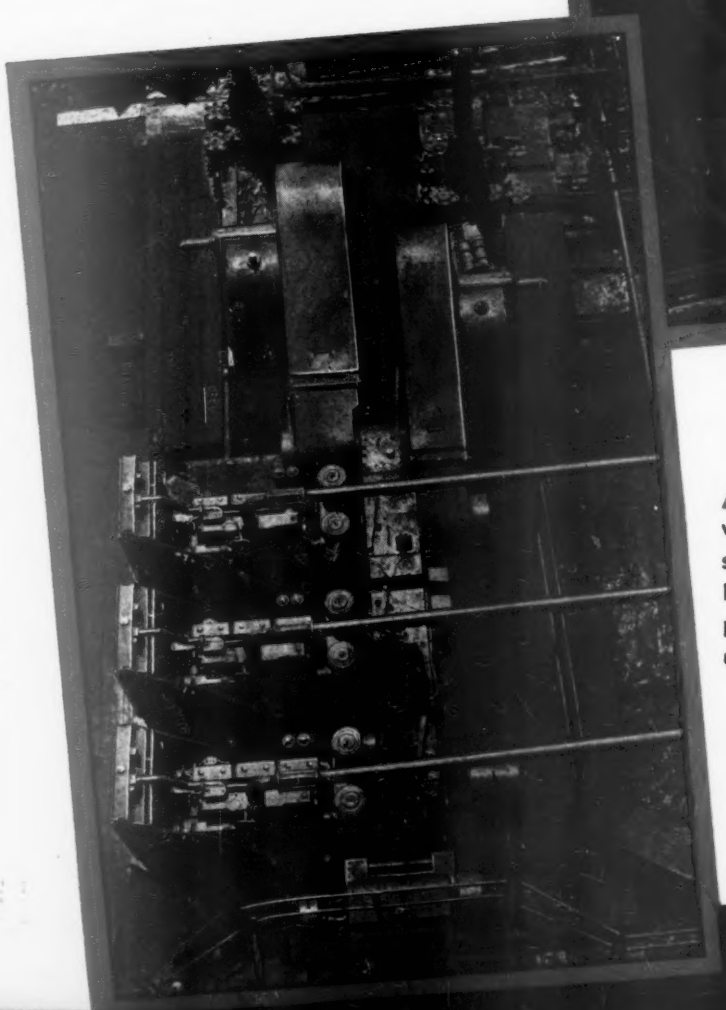
(Continued on Page 202)

THE NEW EMSCO J

POWER

▲ Full view of Emsco J-750 Drilling Unit in position on 10′ derrick substructure, illustrating the condensed application of both engine and pump horsepower. *Notice compactness of entire unit.*

▲ Side view illustrating substructure and pressure lubricated stairstep drive from compounding transmission to selective transmission.



▲ View from third derrick girt showing walk-around platform, selective transmission, compounding transmission, pressure lubricated transmission drives and V-belt pump drives. *Notice compactness of entire unit.*

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Unusual Compactness

▲ Rear full view of Emsco J-750 Drilling Unit, illustrating Fawick Airflex Pump Clutches and Fawick Airflex Engine Clutches together with split type main base and engine skid arrangement. *Notice compactness of entire unit.*

▲ Side view of compounding transmission showing Fawick Airflex Master Clutch, Fawick Airflex Pump Clutch, and illustrating exposed oil lubricating system, air compressor and Thyrite generator mounting.

CONTINENTAL

THE OIL AND GAS INDUSTRIES

(Continued from Page 199)

The turbine bit assembly consists of three main parts: A casing or housing, which is made with a pin for connection to the drill string and which carries the nozzle of the turbine; a shank member, rotatively mounted in the housing, carrying the turbine runner; and the cutter element, which is mounted to rotate on the shank about an axis that is inclined with respect to the axis of rotation of the shank.

Horizontal Drilling Procedure

The turbine bit is attached to the bottom of the curved joint of flexible pipe, which is flexed to a straight position and kept straight by the mandrel. Above this are the required number of straight flexible joints to reach from the vertical bore to the point in the sand where the horizontal hole is to end. These make up the lower portion of the drill string, which consists otherwise of conventional drill pipe. When the bit reaches the depth where the horizontal hole is to take off from the vertical, the mandrel is removed and the curved flexible joint allowed to return to its curved form to the extent the hole will permit. The drill string is then hooked up to the pumps in any convenient manner. Portable surface equipment will usually suffice but the pumps must be able to deliver the necessary volume of fluid at the required pressure and velocity.

When the pumps are started, the bit, being forced by the curvature of the flexible pipe against the side of the vertical hole, will begin to dig into the wall of the bore and start new hole at the point where it is positioned. It has been found that when the string is raised and lowered after removing the mandrel, but before the pumps are started, that the bit, despite the pressure of the curved flexible pipe, will slide up and down within the vertical hole, which makes it possible to change the location of the bit even after the mandrel is pulled. However, as soon as the turbine bit starts to rotate under pump pressure, the bit will immediately dig into the side wall of the vertical hole, at that point where the bit exerts pressure against the wall. Only a very slight weight is carried on the bit during drilling.

Eight Holes in One Well

Drilling procedure is best illustrated by actual performance in testing a well a few weeks ago. In well No. 16-27, 32-22 in the California Midway district, 8 holes were drilled horizontally for the purpose of regaining economic production from a well that had not produced for 17 years. This well was originally drilled in 1918 and last produced one barrel per day of 14-deg. API oil cutting 2.6 per cent in March, 1928, having been shut down ever since that date. In this well 12½-in. casing was cemented and the horizontal holes were drilled from open hole below the casing.

The 8 holes drilled ranged from 10 to 80 ft. and were made with six 6-in. turbine bits connected with 4½-in. flush joint flexible drill pipe. Due to mechanical difficulties the first bit was pulled before it made any hole. Two power pumps were employed during the drilling operation, one 7¼ in. by 10 in. and the other 7¼ in. by 14 in. Turbine bit No. 1 was run into the hole at 929 ft., but was immediately removed because pump trouble was encountered.

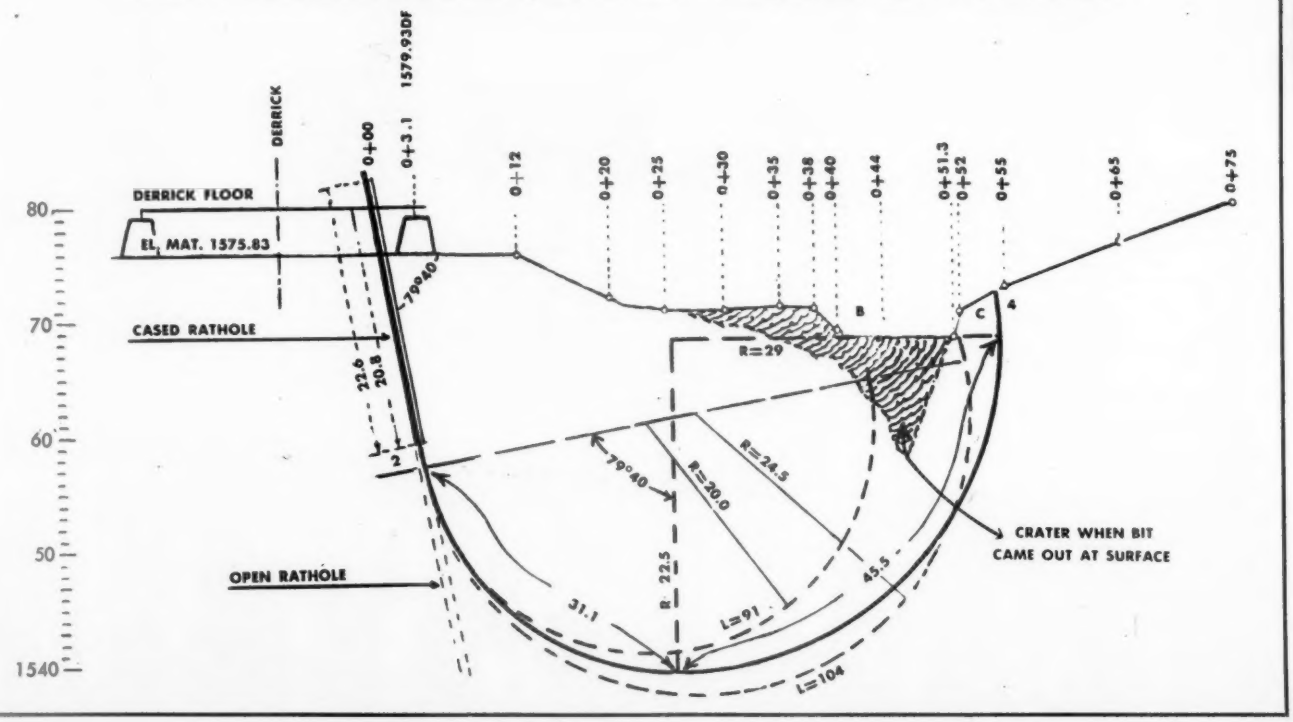
The bit was changed to bit 2, which was oriented into the hole at 929 ft. with 18 ft. of 20-ft. radius curved flexible drill pipe and 92 ft. of straight flexible drill pipe. The conventional drill pipe above was 4-in. full hole. After recovering the mandrel and establishing circulation, drilling was started.

After drilling 10 ft. of hole, the pump was shut down and the bit lowered approximately one foot. It here took 1¼ points of weight and this indicated that the turbine bit was digging new hole. Upon drilling 41 ft. the pumps were again stopped and the drill pipe raised 10 ft., moving perfectly free. The bit was then lowered to bottom and took one point of weight. At 66 ft. the pump was running at 58 strokes per min. with 450 lb. per. sq. in. pressure. When 75 ft. was reached the drilling was stopped and the bit pulled out.

Bit 3 was oriented into the hole at 918 ft. with the same flexible drill pipe as bit 2. The mud weighed 67 lb. per cu. ft. and had a viscosity of 25 sec., 500/500. After starting drilling, a check was made to make sure new hole had been started. The line pressure from the pump was 450 lb. per sq. in. During drilling at 40 ft. the weight indicator showed 0.5 point weight. After reaching 75 ft. drilling was stopped.

Two 31-ft. singles were pulled with the pumps operating and then, after shutting down the pumps, the bit was raised to 910 ft. from 918 ft. where the previous hole had started, being oriented on its way up to drill out the N.75 W. as shown in the table. Drilling was started there and after going 5 ft. a check showed new hole was being made. The mud was 67.5 lb. per cu. ft. with a viscosity of 25 sec., 500/500, the line pressure being 410 lb. per sq. in. After drilling 10 ft. it was impossible to drill further. The bit was pulled out and a 10½ ⅝-in. conventional rock bit on

FIG. 4. Test hole near surface made by drilling through rathole of oil well and maintaining uniform curvature until turbine bit emerged to surface. Solid curved line indicates mathematical curvature of hole. The arcs indicated by broken lines are the probable limits of the actual hole.



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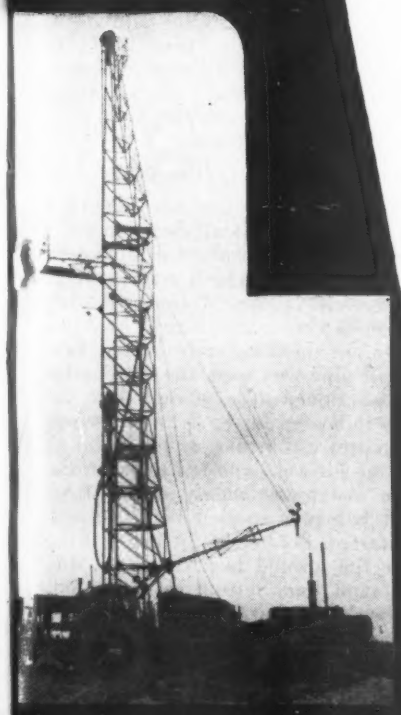

Franks Pioneered Portable "Slim-Hole" Drilling Rigs and Telescoping Derrick Servicing Units

conventional drill pipe was run to clean out the vertical hole to the bottom. Sand bridges were found at 934 to 941 ft. and 974 to 1028 ft.

Bit 4 was now oriented into the well and the drill string was changed to an 18-ft., 20-ft., radius curved flexible joint, 95 ft. of straight flexible drill pipe and the rest of the string 4½-in. full hole drill pipe. The bit was positioned at 883 feet. The first 5 ft. of hole was drilled with a pump pressure of 425 lb. per sq. in. when the pump was shutdown, the string lowered one foot and the bit found taking one point of weight, showing new hole was being made. On drilling again, the pressure increased to 675 and later reduced to 600 lb per sq. in. When 30 ft. had been drilled there was a very strong showing of gas on the ditch, sufficient to cause the fluid to froth over the mud ditch. When the hole reached 48 ft. the bit was slowly pulled out.

After removing a 31-ft. single, the bit was pulled up to 876 ft., being turned 90 deg. clockwise between 883 and 876 ft. The pumps were then started with a pressure of 550 lb. per sq. in. and, after checking to make sure bit was making new hole, drilling continued. After reaching 25 ft., a 31-ft. single was added, the mud at this time being 64 lb. per cu. ft. with a viscosity of 29 sec., 500/500. On starting up again, the pump would not operate properly, partially due to gas-cut fluid, and no hole could be made because of the poor pump action and gas-cut fluid. After pulling out, a 10⅝-in. conventional rock bit was run in conventional drill pipe into the vertical hole and found sand at 1023 ft. The vertical hole was then cleaned out to 1028 ft., new mud mixed and the suction pit, ditch and mud mixer cleaned.

Bit 5 was run to 881 ft. on a 30-ft. radius flexible curved joint 21 ft. in length. Above this were 95 ft. of straight flexible pipe and 765 ft. of 4½-in. full hole drill pipe. After starting new hole, the gas-cut fluid in the hole was pumped into the sump. Drilling was then continued with a pressure of 450 lb. per sq. in. and 0.5 point weight. At 25 ft. the line pressure was 550 to 660 lb. per sq. in. and the mud weighed 63 lb. per cu. ft. At 30 ft. water was added to the fluid and at 40 ft. the viscosity was 35 sec. 500/500. At 55 ft. the pressure was 500 lb. per. sq. in. and there was a strong showing of oil on the ditch. At 65 ft. the line pressure was 300 lb. per sq. in. At 80 ft., where drilling was stopped, the pressure was 225 lb. per sq. in. The mud fluid was too gas-cut to handle and weighed 59 lb. per cu. ft. viscosity 30 sec. 500/500. The drill pipe was pulled with the pumps operating and stuck at 70 ft. in new hole. It was circulated free.

Bit 6 was run to 920 ft. with the same flexible drill pipe as used with bit 5. Additional mud was mixed, consisting of 50 bbl. water, 10 sacks Aquagel, and 25 lb. tetra sodium pyrophosphate. This chemical was only used once, the mud afterwards being cut with water. After removing the mandrel from the curved joint, but before starting the pumps, a test was made. The drill string was lowered slowly and smoothly for 10 ft. and the indicator showed that the bit took no weight. The bit could therefore be moved downward slowly without catching on the side of the hole. With the bit positioned at 920 ft., the pumps were started and 2 ft. drilled with a pressure of 500 lb. per sq. in. The pumps were shut down and the string lowered one foot where the bit took 1½ points of weight, showing the bit was on bottom of new hole. The bit was raised back one foot and drilling continued. Pressure increased to 600 lb. per sq. in. At 45 ft. the mud foamed over the ditch and conductor pipe, the 7¼-in. by 14-in. pump then operating at 52 strokes per min. and the weight on the bit being 0.5 point. At 57 ft. 148 lb. new mud was added, a portion of the oil and gassy mud being dumped. At 60 ft. the line pressure was from 550 to 600 lb. per sq. in. At 64 ft. there were strong oil and gas showings on the ditch with the pump operating at 62 strokes per minute. At 70 ft. the pressure was 475 to 550 lb. per sq. in. Drilling was stopped at 75 ft.

One single was pulled with the pump operating and then a second single was pulled with the pump shut down. The bit was pulled to 919 ft. where the drill pipe was turned 180 deg. clockwise and lowered 3 ft. The pump was started and, with a line pressure of 450 lb. per sq. in., the drill pipe was lowered immediately 5 ft. The bit did not take any weight so it was pulled back to 922 ft. and let stand for 2 min. with the pump operating. On feeling for bottom the indicator showed that the bit took 1½ points weight. After drilling 3 ft. the pump was shut down. On then lowering the drill pipe one foot the bit took 1½ points of weight, showing it was making new hole. After drilling 15 ft. the pressure fell from 450 to 400 lb. per sq. in., the mud weighing 61 lb. per cu. ft. At 20 ft. there was a strong showing of oil and gas on the ditch. At 24 ft. the pressure was 350 lb. per sq. in. and the pump was operating at 75 strokes per min. The pressure continued to decrease and after drilling beyond 30 ft. the pressure was 275 lb. per sq. in., the mud 60.5 lb. per cu. ft. and the viscosity of the fluid 30 seconds. The pump at this time was operating at 72 strokes per min. Hole was continued to 35 ft. when drilling was stopped and the string started out of the hole with pump running. The bit was gummed up.

During the drilling of the 8 holes described above, the speed of drilling varied to some extent. The overall time for the operation, with the running of the second bit, is shown in the table. Actual drilling time while making hole averaged considerably more than one foot per minute. In drilling with bit 4, for example, the 28 ft. from 20 ft. to 48 ft. was drilled in 11 min. and during part of this time gas showings strong enough to cause the mud fluid to froth were encountered.

Control of Hole Direction

A test to demonstrate the accuracy with which the vertical direction of a hole drilled with the curved flexible drill pipe can be determined was made at another well in the Midway District. This test is shown graphically in Figs. 4 and 5. In this case only curved flexible drill pipe was used, the turbine bit being positioned at a point in the rat hole as indicated in the drawing before the mandrel was removed. The point at which the bit was expected to reach the surface at approximately 60 ft. from the rat hole was located before operations started. Before the bit reached the surface the ground began to cave, due to the mud fluid jetting from the bit, but in spite of that, the predetermined

PRODUCTION RECORD
Midway Well No. 16-27, 31/32

Horizontally drilled in 1918.

Produced until 1928, then shut down as daily production was only 1 bbl., with 12 to 14 gravity.

Seventeen years later, June 1945, well reopened and sidetracked.

Seven horizontal drain holes were drilled. Total length, 421 ft.

Fluid level stood 300 ft. high after holes drilled.

Pump operated at 4 strokes per min., 26-in. stroke.

Started producing at 3 bbl. per day, with 50 per cent sand.

No accurate daily records were kept from July 16 to July 21, during changes in pumping cycles and experimental work.

Production records:

	Date	Bbl.	Gravity	Per Cent sand
July	21	12	12.9	35
	22	13	12.9	35
	23	14	12.9	35
	24	18	12.9	35
	25	22	12.9	35
	26	21	12.9	35
	27	14	12.9	20
	28	13	12.9	15
	29	12	12.9	15
	30	20	12.9	15
	*31	13	12.9	15
August	1	20	12.9	15
	2	20	12.9	15
	3	20	12.9	15
	4	20	12.9	15
	5	19	12.9	15
	6	18	12.9	15
	7	18	12.9	15
	10	22	12.9	10
	11	22	12.9	10
	12	22	12.9	10
	13	22	13	10
	14	22	13	10
	15	20	13	10
	16	25	13	10
	17	25	13	10
	18	23	13	8
	19	26	13	8
	20	26	13	8
	21	26	13	8
	22	21	13	8
	23	24	13	8

*To this date, well produced some water, no water thereafter.

By pumping less sand, the pump is operated faster, thereby increasing production.

The above production figures are net barrels, exclusive of water and after sand was separated from the oil.

The maximum daily production is apparently not yet reached. It will be interesting to watch the production figures for the following months.

point of exit was within ten feet of the place where the bit actually emerged.

Advantages of Drain Holes

The method of producing oil through drain holes deviating from a vertical bore into an oil sand offers definite advantages both for new and old wells in the primary recovery of oil and for wells being produced by some system of secondary recovery.

For primary recovery there are three main advantages:

1. *Increase of production of oil for a given well through curved drain holes drilled in any number and at any depth radially into the oil sand surrounding the vertical well from which they deviate.*
2. *Protection from floating sand clogging the well by flowing the oil through drain holes at less speed and settling the sand before the oil reaches the vertical well. The drain holes can be gravel packed where it is necessary to increase the retention of floating sand within the pack.*
3. *Prevention of escape of gas by flowing oil first downwardly and then upwardly through drain holes curved upwardly at both ends, keeping by proper flow control the lowest part of the drain holes always full of oil, forming a liquid seal, shutting off an undesirable escape of gas, accumulating the gas in the upper part of the oil sand and producing oil under a downward or "gas-cap drive," which is one of the most effective methods of production.*

For secondary recovery the present method of gas repressuring will greatly benefit by the presence of the drain holes because by-passing of gas is prevented by the drilling of the drain holes in the proper direction between intake and producing wells, the flow of pressure gas being controlled through drain holes and sand bodies as a matter of least resistance.

Drilling Drain Holes

The drilling of drain holes in old wells can be done at any depth. With few exceptions all pumping or flowing wells will benefit by holes drilled horizontally from the bore of the vertical well. The drilling of the drain holes can be done in either of two ways:

1. *The old liner can be pulled and, if casing extends over the stratum to be drained, a section of the casing can be drilled out to the desired depth. Several drain holes are drilled in different directions, being staggered vertically several feet apart or in proportion to the thickness of the sand. The drain holes may be left open or filled with gravel. New perforated liner is then set in the vertical bore of the well, covering the mouths of the drain holes. Tubing and pump are set in the well below or above the drain holes according to the capacity of the well.*
2. *The old liner can be pulled and either oriented or non-oriented windows cut into the casing at the desired points. When the turbine bit and flexible drill pipe are run into the well and the mandrel removed, the curved joint of flexible pipe will cause the bit to pass out through the window when the bit is rotated, the bit having been lowered to the proper depth. A turn of the drill string will allow the bit to find the window with evidence at the surface if the bit happens to be pressing against the casing at a point circumferentially away from the window. The drilling then proceeds as described. Excess space in windows can be closed with special shields if well is a large, high-pressure producer.*

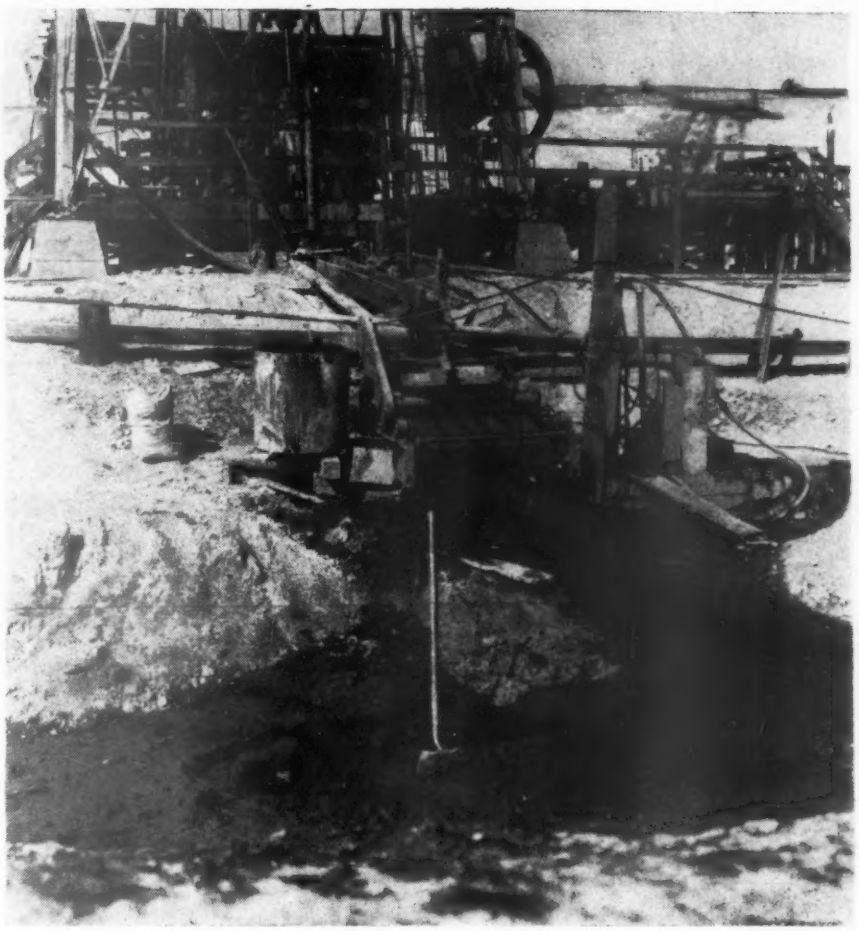

FIG. 5. Blowout or crater marked at shovel indicates where turbine bit emerged from test hole after drilling down through rathole of oil well. Casing in rathole with end of flexible drill pipe and swivel visible in derrick.

Wells producing from loose sands become clogged around the well bore by floating sand and colloidal matter. Drain holes drilled beyond the clogged area give old wells new production by reaching out into sands having greater permeability. The reduced resistance of flow through the looser sands which are not sealed with colloidal matter, and which are reached by the drainage holes, greatly increases production, according to Zublin.

New wells will benefit when a number of drain holes are drilled before the well is brought in. Due to the largely increased area of contact between formation and drain holes, a new well can be produced at a greater capacity without exceeding its limit of efficient production. The maximum pressure differential between hole and formation is moved from the vertical well bore itself toward the ends of the drain holes where it affects a far greater volume of virgin oil sand. From this greater mass of sand the oil can be drained in large quantities and at such low velocities that, despite increased production, the retention of gas and sand within the formation becomes possible.

Technique Developed by Experience

The mechanical operations of drilling horizontal drain holes are simple and vary only slightly when different kinds of sands are to be drilled. The following points have been observed by the actual drilling of horizontal holes from a vertical bore:

1. The drain hole should be drilled for its full length in one round trip.

2. The drain holes, with present equipment, should be drilled approximately 80 ft. long.

3. The curved hole taking off from the vertical bore should have a radius of 25 ft. to reach most effectively the 80 ft. length.

4. Very light mud should be used and the turbine bit and flexible drill pipe should be withdrawn as soon as the horizontal hole has been completed.

5. The horizontal drain hole should be drilled with speed and should average approximately 1.5 ft. per min. The

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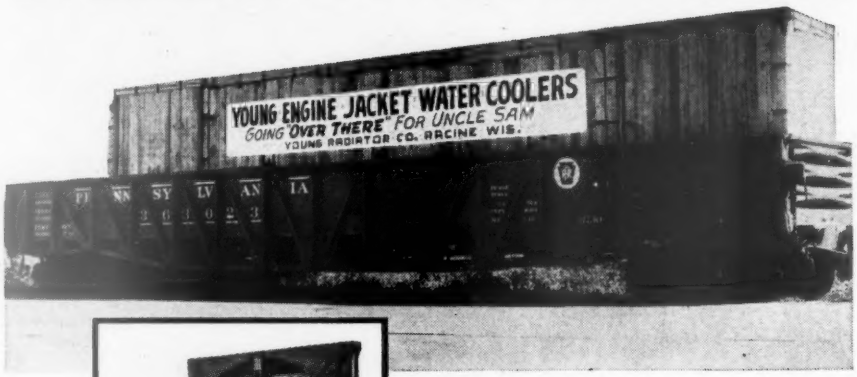

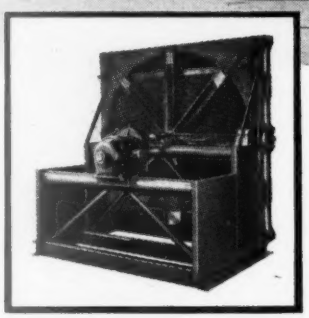

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turbine inside the bit rotates at 4000 r.p.m. and will wear whether the bit makes hole or not.

6. A powerful mud pump should be employed and should be capable of delivering 400 gal. per min. of light, non-abrasive fluid at a pressure of 700 lb. per sq. in. at the pump.

7. An accurate weight indicator should be used. The weight registered on the turbine bit should range from 1/8 to 1½ tons maximum.

8. An efficient mud screen-shaker should be employed to prevent abrasive sand from re-entering the turbine bit.

9. At a convenient place between the pump and the rotary hose there should be inserted a heavy plate, perforated with several hundred 3/16- in. holes to prevent small rocks and pieces of rubber or other foreign substances from entering the flexible pipe and blocking the veins of the turbine bit.

The drilling of longer drain holes in harder oil sands may require more than one round trip. This, however, is no inconvenience because the turbine bit will always find its hole which, in such sands, has walls sufficiently firm to allow repeated lowerings and withdrawals of the turbine bit and the flexible drill pipe.

The ultimate length of horizontally drilled drain holes cannot be determined at this time. With the advance of horizontal drilling technique, however, it is believed that drain holes of several hundred feet can be drilled. Methods of orientating drain holes will also be facilitated as the practice becomes more extensively developed.

New Practice Necessary

The protection of the finished hole, such as is given to a vertical bore, is not necesary because in the event of a partial destruction of the round bore of a horizontal drain hole (particularly when there are several such holes) does not imply the full loss or even partial loss of production—something that would be inevitable under present methods of production—if the single vertical bore should cave.

Although flexible perforated liners can be set in curved drain holes, in loose oil sands their insertion is difficult; and for heavy oil their value is doubtful. In most cases it will be easier to drill a new horizontal drain hole than to clean out the flexible liner of an old drain hole.

Gravel packs in drain holes should be considered for larger wells where floating sand can reach the pump. Gravel of approximately one-half inch in diameter should be given consideration in experimental work. This gravel can be removed easily if a redrilling of drain holes becomes necessary.

Open drain holes with as little mud deposit and without gravel are recommended for small pumpers of low gravity oil. Four drain holes at least should be drilled in a well, each deviating 90 deg. from the other, the holes staggered vertically at about 5 ft. apart. In places where the oil sand has sufficient thickness a larger number of horizontal drain holes can be drilled. ★ ★ ★

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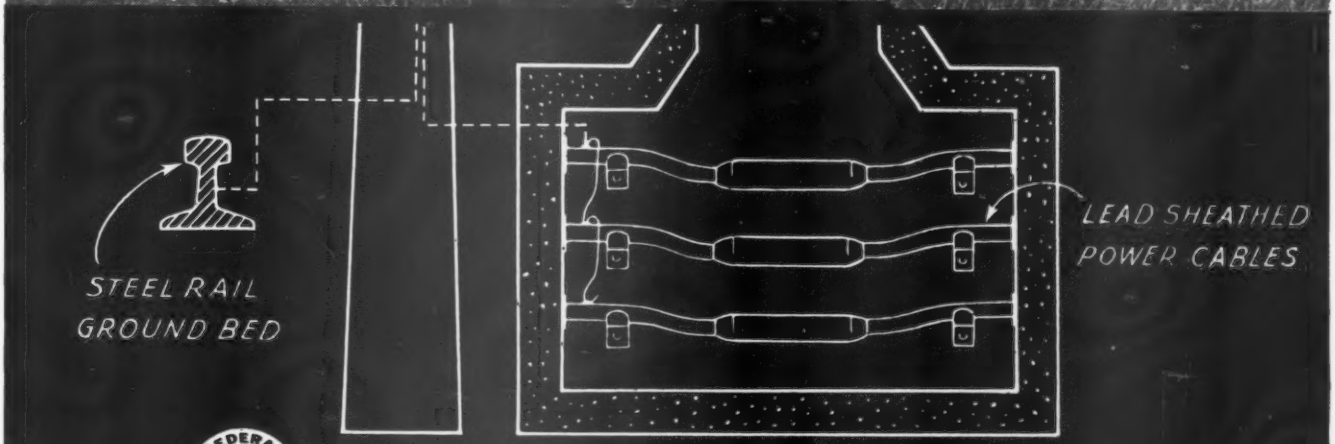

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TCC CATALYTIC CRACKING PROCESS FOR MOTOR GASOLINE PRODUCTION*

By R. H. NEWTON†, G. S. DUNHAM‡, and T. P. SIMPSON§

THE catalytic cracking of petroleum fractions has permitted the production of vast quantities of gasoline of higher octane rating than other processes that would produce the same volume of gasoline. The development and acceptance of catalytic cracking has been rapid, and of course, has been spurred on by the war. The first commercial plant employed the Houdry fixed bed process and was placed in initial operation at Paulsboro, New Jersey, in 1936. The gradually rising octane standard for automotive gasoline, as a result of keen competition and a consumer market that is extremely sensitive to slight variations in octane number, has forced the replacement of thermal cracking, which produces 65-70 octane gasoline with catalytic cracking making 80 octane or higher. During the war, the high octane base stocks produced by catalytic cracking are of tremendous importance in meeting our needs for 100 octane aviation fuel, but at the conclusion of hostilities, the demand for such fuel will decrease, and most of the high octane components will find their way into motor gasolines of greatly improved quality than those heretofore available.

Inasmuch as the octane number of all regular grade gasolines must meet the minimum of consumer demand, and since present catalytic cracking facilities are concentrated in a limited number of refineries, it is expected that the installation of more facilities will continue after the war in order to balance the production at those plants not now having catalytic cracking equipment.

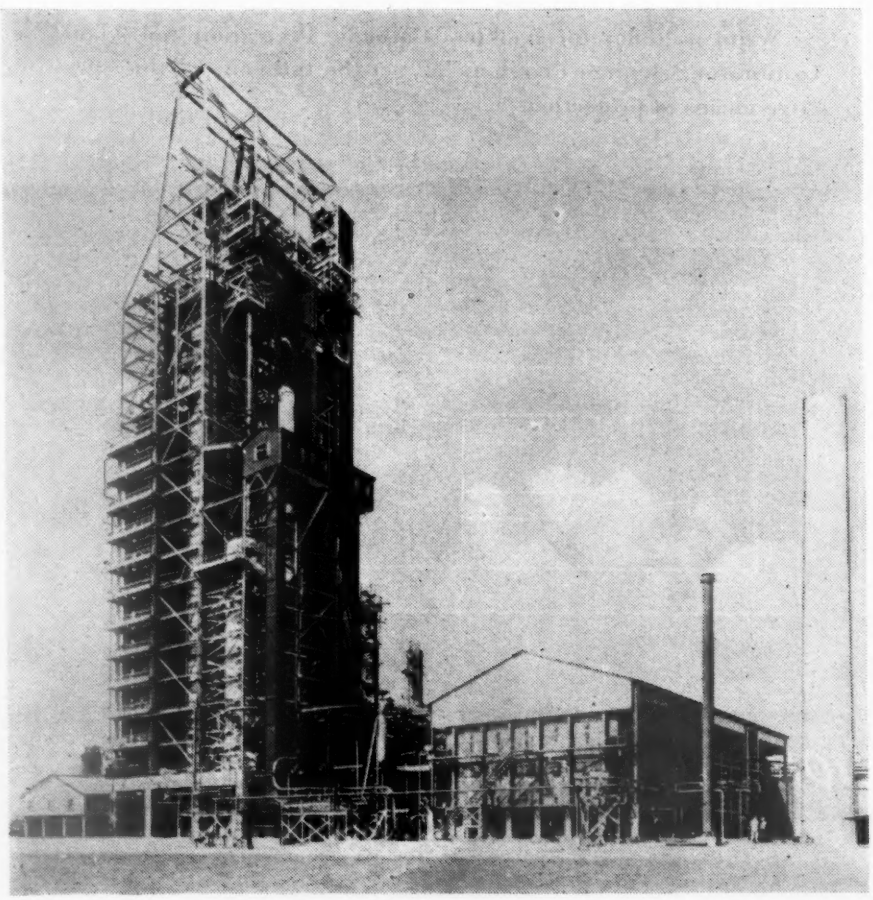
*Presented before the American Institute of Chemical Engineers at St. Louis, Missouri, November, 1944.

†Houdry Process Corporation, Marcus Hook, Pennsylvania.

‡Socony-Vacuum Oil Company, Inc., New York, New York.

§Socony-Vacuum Oil Company, Inc., Paulsboro, New Jersey.

General view of TCC catalytic cracker.

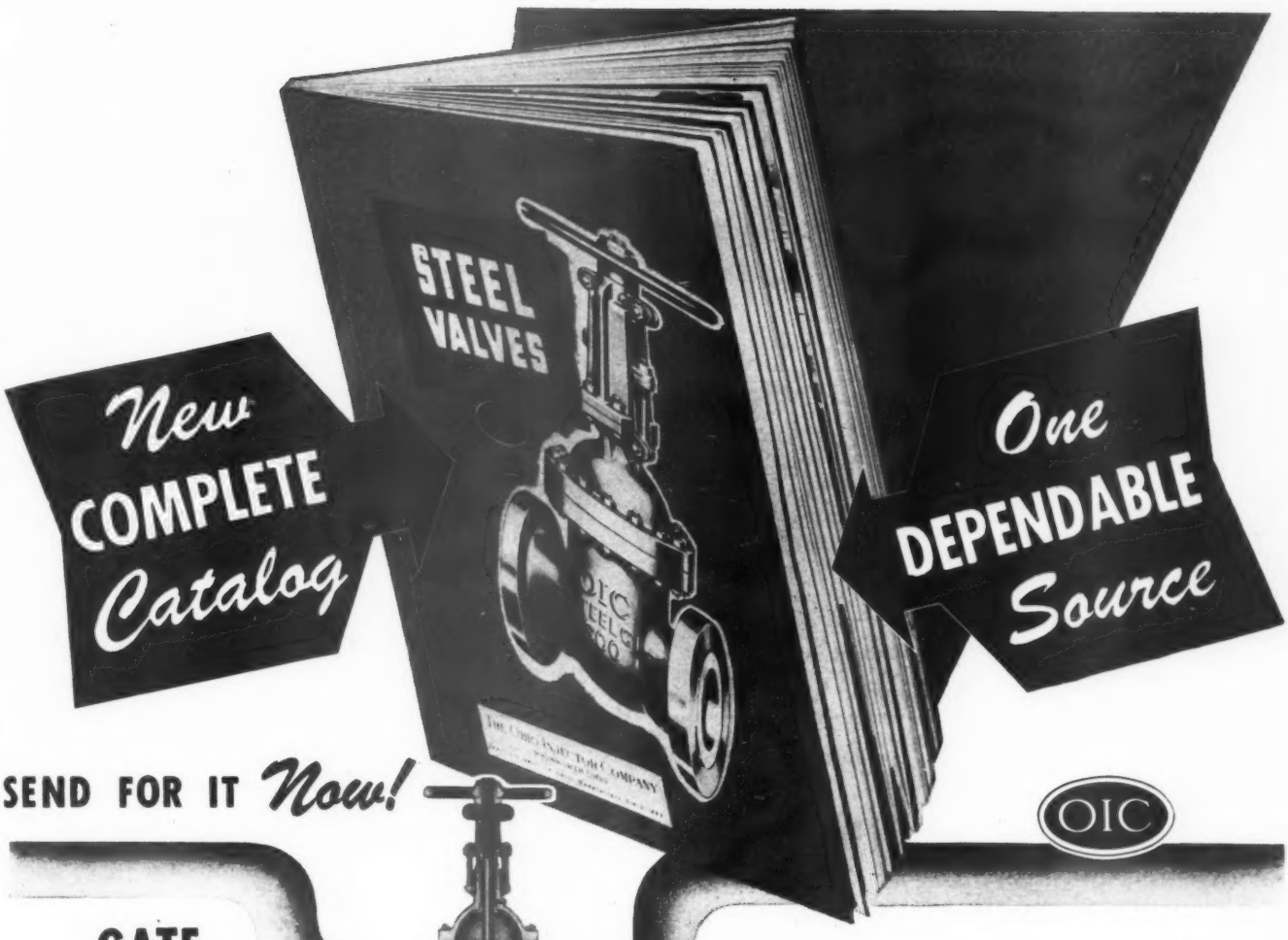


In general, in the Houdry and *TCC* catalytic cracking processes, a stream of vaporized oil is passed through a bed of cracking catalyst that breaks down the heavier molecules. The catalysts currently in use are pellets of activated natural clay or synthetic pellets and beads of the silica-alumina type. The products of cracking are light gases, commonly referred to as propane and lighter; a *B-B* fraction consisting essentially of isobutane and butylene; a gasoline cut consisting of iso-paraffins, aromatics, and lesser amounts of olefins and naphthenes; a gas oil cut which is richer in aromatics than the virgin gas oil; and a carbon deposit on the catalyst. The proportions of these materials and their compositions vary with operating conditions. It might be noted that the high quality of the cracked gasoline is largely due to the presence of isoparaffins and the absence of normal paraffins as well as to the character of the olefins present. The deposit of carbon on the catalyst requires a regeneration with air to remove it and present a fresh catalyst to the oil.

As mentioned before, the first commercial catalytic cracking units employed the Houdry fixed bed principle. These plants, now numbering about 30, demonstrated the technical feasibility and economic advantages of catalytic cracking.

During the development and commercialization of the fixed bed units, the Socony-Vacuum Oil Company, Inc., instituted research on the design of a unit employing the moving catalyst principle, and carried this program through to the successful installation and operation of 34 commercial units. Today Houdry Process Corporation offers for licensing these two processes employing the same basic principles, but differing in application. The engineering development in both processes is well advanced and assures a minimum of operating difficulties. Simpson, et al,[3] have given a description of the process features for the *TCC* cracking process for production of aviation gasoline.

● **The *TCC* Process.** A schematic flowsheet of a *TCC* unit is given in Fig. 1. The *TCC* unit consists of two vessels, one a reactor in which oil passes through a bed of catalyst from 8 to 35 ft. in depth. The catalyst bed is moved downward at a uniform rate and removed at the bottom, whence it is transported in a bucket elevator to the second vessel or regen-



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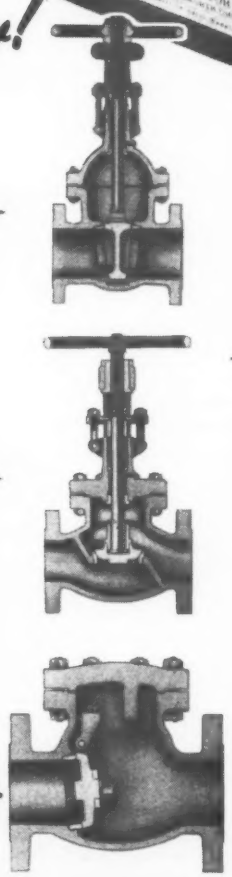

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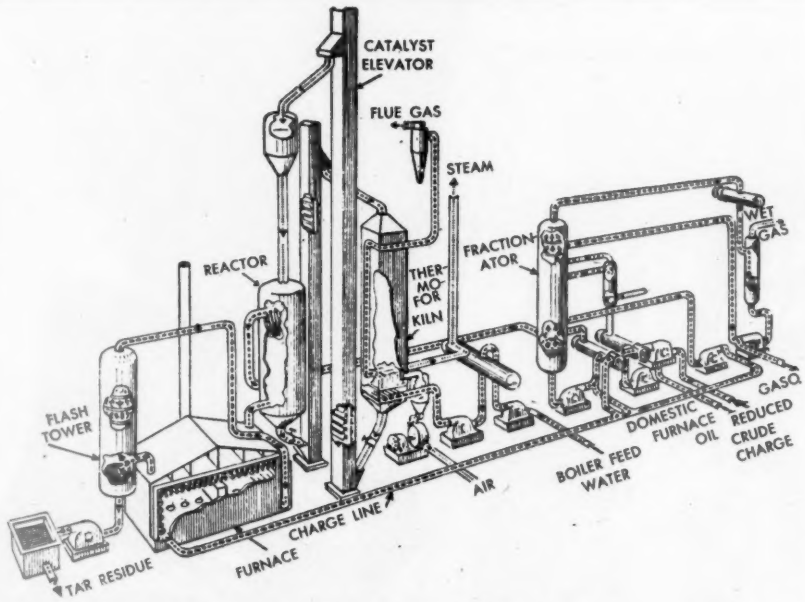


FIG. 1. General process flow diagram of the TCC plant, showing the essential units of the equipment required for feed preparation, catalytic cracking and regeneration, and distillation of products.

erator. As in the reactor, the catalyst moves downward at a uniform rate, but is passed through a series of alternate burning and cooling zones; air is admitted to and fumes removed from each burning zone, and between the burning zones, the catalyst is cooled by generation of steam in cooling coils. The reactor vessel is extremely simple and normally employs the principle of counterflow wherein clean catalyst is first contacted with partially cracked and the more refractory oil, leaving the initial cracking, which is easily accomplished, on the partially spent catalyst. The use of a solid bed of cracking catalyst insures good distribution of oil throughout the catalyst.

There are a number of distinctive chemical engineering features of the process, which required careful laboratory study in establishing the proper design. The size of catalyst particle chosen was 0.1 to 0.2 in. in diameter and was determined as sufficiently large to be conveniently manufactured, and of proper size to permit ready flow of vapors through a bed, and at the same time, permit proper diffusion into the individual particles. The problem of handling such material and distribution of flow, both of solid and of vapors, received a great deal of attention. The overall design of commercial sized plants showed elevators of about 200 ft. lift to be necessary. Such elevators operating as a single lift for transporting catalyst at 900-1000°F. were designed through cooperation of the Jeffry Manufacturing Company, Lummus Company, and Socony-Vacuum Oil Company, Inc. Operating experience to date (over a year) has been very satisfactory. To insure smooth vertical downward movement of catalyst, the rate of flow of oil vapors through the bed must be controlled below that point where "boiling" begins. In practice the maximum permissible pressure drop is somewhat less than the weight of catalyst. The pressure drop through beds of catalyst is found to agree well with the data published by Chilton and Colburn,[1] when corrected for average inlet and outlet conditions. Obviously, the lifting or boiling effect is most pronounced where the oil vapor leaves the catalyst, since the molecular weight is the lowest at this point. The pressure drop through a deep bed is of considerable help in producing uniform flow throughout the bed; however it is generally felt that provision for uniform distribution should be made at the inlet and outlet points.

Another engineering factor of considerable interest is the distribution of flow of catalyst particles to insure vertical movement of the bed. Laboratory experiments were made to determine not only the rate of catalyst flow through various openings, but also the type of flow. It was found that when there was a single opening in the center of a vertical cylindrical vessel, 24 in. in diameter or less, the flow of catalyst was vertical whenever the depth of bed exceeded 1.5 times the diameter of the vessel. At the lower depths, appreciable coning occurred, and there was visible cross-flow of catalyst. This condition necessitated that a bed depth of at least 1.5 times the spacing of the distributor holes be allowed above the flow control plate. The type of flow observed in these experiments was extremely interesting and is illustrated in Fig. 2. The diagram shows several successive positions of the surface of the pellets. When the depth exceeds 1.5 times the diameter of the container, the surface is horizontal and moves downward uniformly. If the bed depth exceeds 1.5 times the diameter, the material outside a cone of included angle 38 deg. is substantially stagnant. The apparent angle of repose is 71 deg., as compared to the static measurement of 34 deg. As the level of the catalyst drops,

TABLE 1

Typical TCC heat balance

Charge rate....8,751 bbl. per day		
Gravity..... 31 °API		
Oil and steam to reactor.....	935° F.	
Vapor temp. from reactor....	950° F.	
Catalyst to reactor.....	995° F.	
Catalyst from reactor.....	875° F.	
Steam to vaporising section.....		4,200-lb./hr.
Steam to stripping section.....		3,200-lb./hr.
Gas products... 6.7% wt.		7,500-lb./hr.
BB cut..... 9.4% vol.— 6.1% wt.		6,800-lb./hr.
Gasoline.....40.8% vol.—35.2% wt.		39,400-lb./hr.
Total cracked products.....		53,700-lb./hr.
Coke produced.....		4,150-lb./hr.
Gas oil.....		54,400-lb./hr.
Reactor charge.....		112,250-lb./hr.
Adsorption of H_2O in reactor.....		830-lb./hr.
Catalyst circulation...106 tons/hr.		
Catalyst to kiln.....	865° F.	
Catalyst from kiln....	1005°F.	
Steam generation.....		21,100-lb./hr
		86,000-lb./hr
Air to preheater 18,100 CFM at.....	60° F.	
Air to kiln preheated to..	501° F.	
Air leaving kiln.....	978° F.	
Flue gas analysis.. 9.2%	CO_2	
6.6%	O_2	
4.0%	CO	
80.6%	N_2	
11.7%	H_4O vapor % gas vol.	
H/C ratio in coke....=	.089	
CO_2/CO ratio in flue gas.....=	2.3	

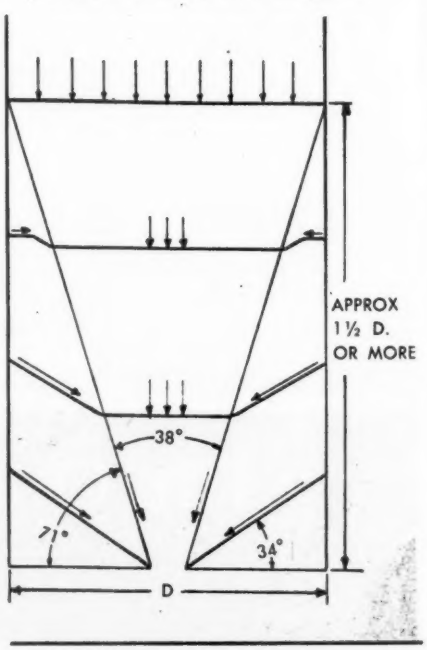
Reactor balance—basis, 1 hr.

	B.t.u. heat input	B.t.u. heat output
Catalyst.....	6,350,000	
H_2O absorption.....	1,290,600	
Carbon on catalyst.....	50,400	
Heat of cracking.....		6,020,000
Oil products.....		1,140,000
Steam.....		31,000
Heat loss est.....		500,000
	7,691,000	7,691,000

Kiln balance

	B.t.u. heat input	B.t.u. heat output
Carbon burned.....	64,800,000	
Catalyst.....		7,410,000
Desorption of H_2O.....		1,290,600
Temp. inc. of desorbed H_2O..		47,000
Steam generated.....		21,100,000
Est. heat loss.....		8,000,000
Air to kiln.....		10,300,000
H_2O in air to kiln.....		418,000
H_2O from combustion.....		187,000
Accounted for.....		48,762,000
Unaccounted for.....		16,038,000
	64,800,000	64,800,000

FIG. 2. Catalyst flow diagram.



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a cone appears in the center, the diameter of which is approximately determined by the apparent 71 deg. angle of repose. Outside of this point, the surface remains level by a horizontal motion of the catalyst particles. At an average height between one-half and one diameter, the exterior part of the cone assumes a static angle of repose of 34 deg., and the motion is parallel to the surface. As before, the area within the 71 deg. apparent angle of repose moves substantially vertically downward.

The rate of flow of catalyst from any orifice is generally restricted by the catalyst below, but it was essential to know the limiting maximum rate of flow. The following equation was found to express the experimental data:

$$F = 8.50D^{2.96}H^{0.04}$$

or

$$f = 10.8D^{0.96}H^{0.04}$$

Where:

F = catalyst flow in lb. per min.
D = diameter of orifice in in.
H = head in ft.
f = catalyst flow in lb. per min. per sq. in.

This relationship is unique as far as is known. It shows that head has almost no effect, whereas the flow is directly affected by the diameter of the hole as well as its area. This formula holds where the diameter of the hole is greater than 6 times the particle diameter. Below this diameter, flow is very irregular. A plot of the experimental data is given in Fig. 3.

In order to check these flow experiments, transparent models were made to full commercial dimensions, and the catalyst flow carefully observed by use of multi-colored pellets. This allowed considerable assurance that the methods of control of catalyst flow were sound.

In the regeneration phase, it is essential to maintain a given minimum temperature to insure the initiation of combustion and also to limit the maximum temperature to about 1150°F., to prevent excessively rapid deterioration of the catalyst. The present design calls for alternate burning and cooling zones to accomplish these aims.

The rate of combustion of the carbon deposit on catalyst pellets has been studied carefully for the various types of regenerating equipment. The utilization of air, at several rates of flow, is shown as a fraction of carbon burned in Fig. 4, as an illustration. When air is first passed through a bed of catalyst at the rate used, the oxygen in the air is substantially completely consumed. This condition persists until about one-third of the carbon is burned, then the oxygen concentration rises with a decreasing rate of combustion. When about 70 per cent of the carbon has been burned, the rate of combustion is relatively slow, and the carbon remaining is completely cleaned up by a longer exposure. Thus the rate of combustion in the upper portion of the kiln is determined largely by the rate at which air is furnished to each section. In the center sections, the air is incompletely utilized, and in order to make the best use of it, it is essential that the temperature of the catalyst be as high as possible within the limits set by catalyst stability. The lower sections provide a sufficient holding time in accord with the description of combustion given above.

The amount of carbon that can be burned in each combustion zone depends on the limits of inlet and outlet catalyst temperature for each zone. For a plant having a catalyst circulation of 100 tons per hour, it is possible to remove 5,000,000 B.t.u. per hr. from each section by allowing the catalyst temperature to rise 100°F. If no heat is removed by the air stream, this corresponds to a combustion rate of 357 lb. per hr. of carbon in the section. However, it is preferable to use cold regeneration air in the upper zones where combustion is rapid; the additional heat removed in heating this air from atmospheric amounts to about 1,500,000 B.t.u. per hr.; so that 30 per cent more carbon can be burned, making a total of 464 lb. per hr. per section. Presently, operating kilns have from 7 to 10 burning sections.

Another factor of considerable importance in the operation of the *TCC* unit is the isolation of the oil system from the air by means of pressure seals of inert gas. It is a well known fact that a pressure differential can be maintained across a pipe full of catalyst particles by maintaining a flow of gas through it. This is exactly the principle employed in sealing the top and bottom of the reactor. The top and bottom differ, however, in that at the top, the flow of sealing gas and catalyst are counter-current,

FIG. 3

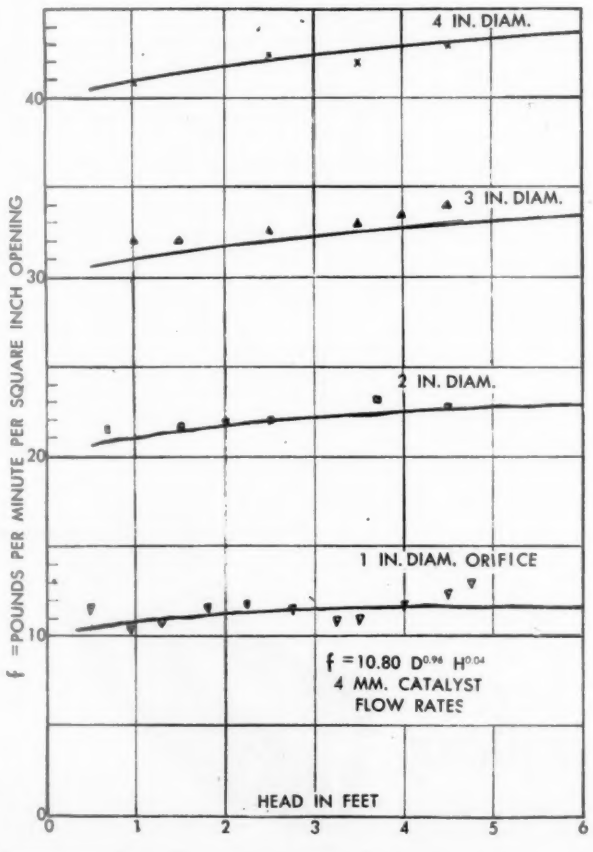
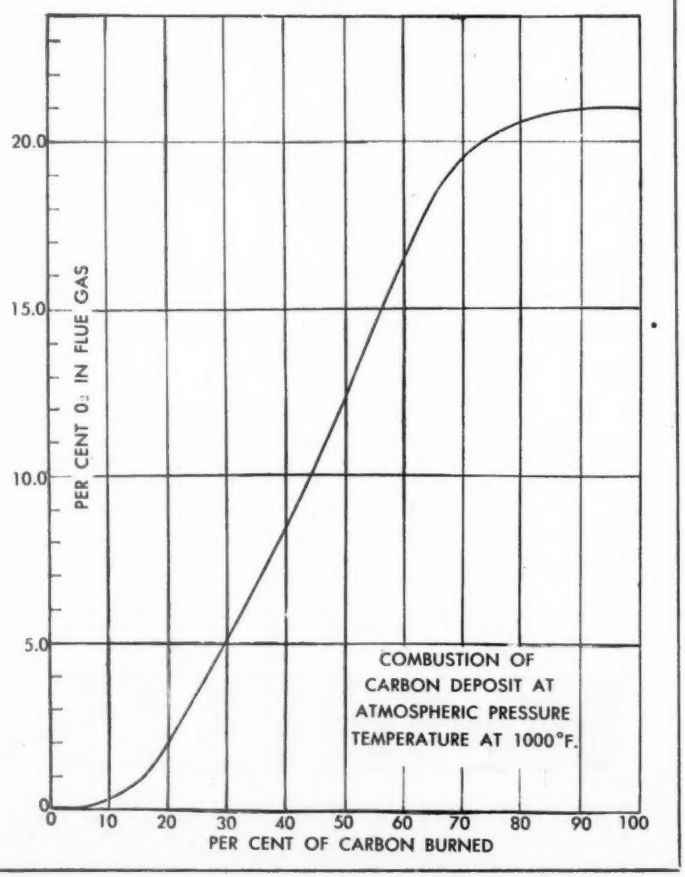


FIG. 4



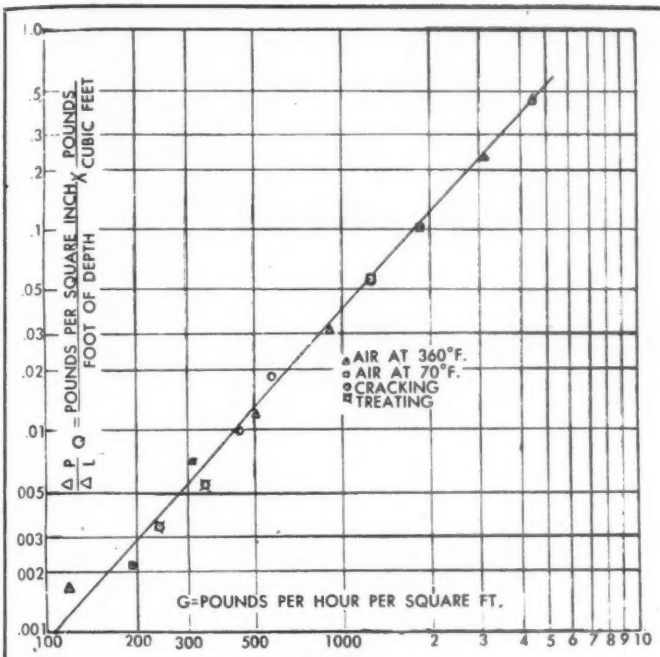


FIG. 5

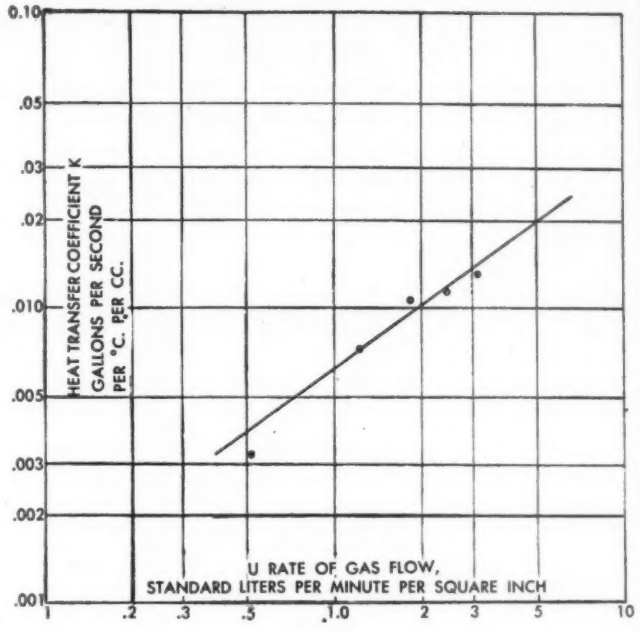


FIG. 6

and in order not to stop the downward flow of catalyst, the gas flow must not exceed that giving a pressure drop of about 6 in. of water per foot of height. This allowable minimum pressure drop is about 70 per cent of the weight of catalyst per foot of height. In laboratory studies, the flow of catalyst in a smooth container is not ordinarily interrupted by a flow of gas until the pressure drop equals or exceeds the weight of catalyst. However, once the flow is stopped or "bridging" has occurred, the pressure drop must be decreased appreciably to re-establish flow. The use of a maximum figure of 70 per cent of the weight for allowable pressure drop permits a factor of safety to take care of gas surges, and except in very unusual circumstances, allows the catalyst flow to re-establish itself when the pressure surge subsides.

As mentioned before, this pressure drop may be calculated with sufficient accuracy from the data of Chilton and Colburn.[1] In modified form and applied to gas flow in the turbulent region through *TCC* clay catalyst this is:

$$\frac{\Delta P}{\Delta L}\rho = \frac{1}{2{,}040{,}000} G^{1.64}$$

where

$\frac{\Delta P}{\Delta L}$ is pressure drop in lb. per sq. in. per ft. of length.

ρ = vapor density in lb. per cu. ft.

G = superficial mass velocity of vapor in lb. per hr. per sq. ft.

The data on air, flue gas, and hydrocarbon vapors appear to fit this relationship. A plot of this equation, together with typical data points from plant operations is given in Fig. 5.

For the accuracy required in these calculations, the viscosity of the gas can be neglected, due to the low power to which Z occurs in the turbulent region. The data apply to values of $\frac{D\rho G_o}{Z}$ greater than 0.3 where $D\rho$ is the diameter of the particle in inches, G_o the rate of flow in pounds per square foot per second, and Z, the viscosity in centipoises.

An overall heat balance for the operation of both reactor and kiln is given in Table 1. There are still several factors of the heat balance on commercial units that are under investigation since they are not clearly understood. These data were obtained from a commercial plant of somewhat different internal design than the one discussed. However, it serves to show the magnitude of quantities of heat being considered. In the reactor, the heat of reaction, which is endothermic, is furnished from two major sources—heat in the entering oil vapors,

(Continued on Page 220)

FIG. 7. TCC reactor details.

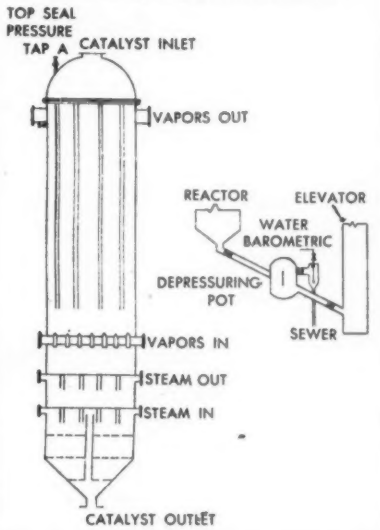


FIG. 8. TCC reactor—oil feed grid.

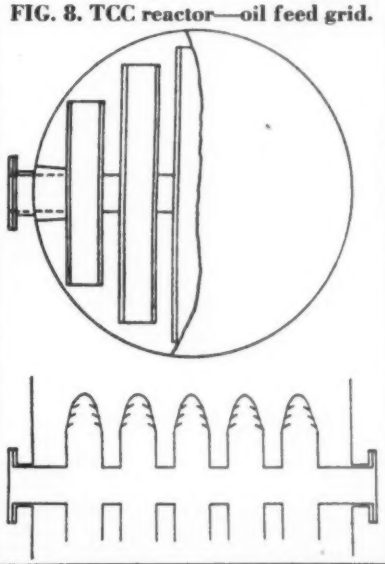


TABLE 2

Operating conditions in TCC kiln

Catalyst temperatures				Burning		Cooling	
Burning zone		Cooling zone		Damper position	Temp. rise, approx.	Coils in use	Temp. fall
Inlet, approx.	Outlet	Inlet	Outlet				
915	1005	1005	995	Wide open	90	0	10
995	1040	1040	960	⅓ open	45	2	80
960	1040	1040	975	Wide open	80	1	65
975	1065	1065	1020	Wide open	90	1	45
1020	1050	1050	1010	⅓ open	30	1	40
1010	1070	1070	1025	Wide open	60	1	45
1025	1065	1065	1010	Wide open	40	1	55

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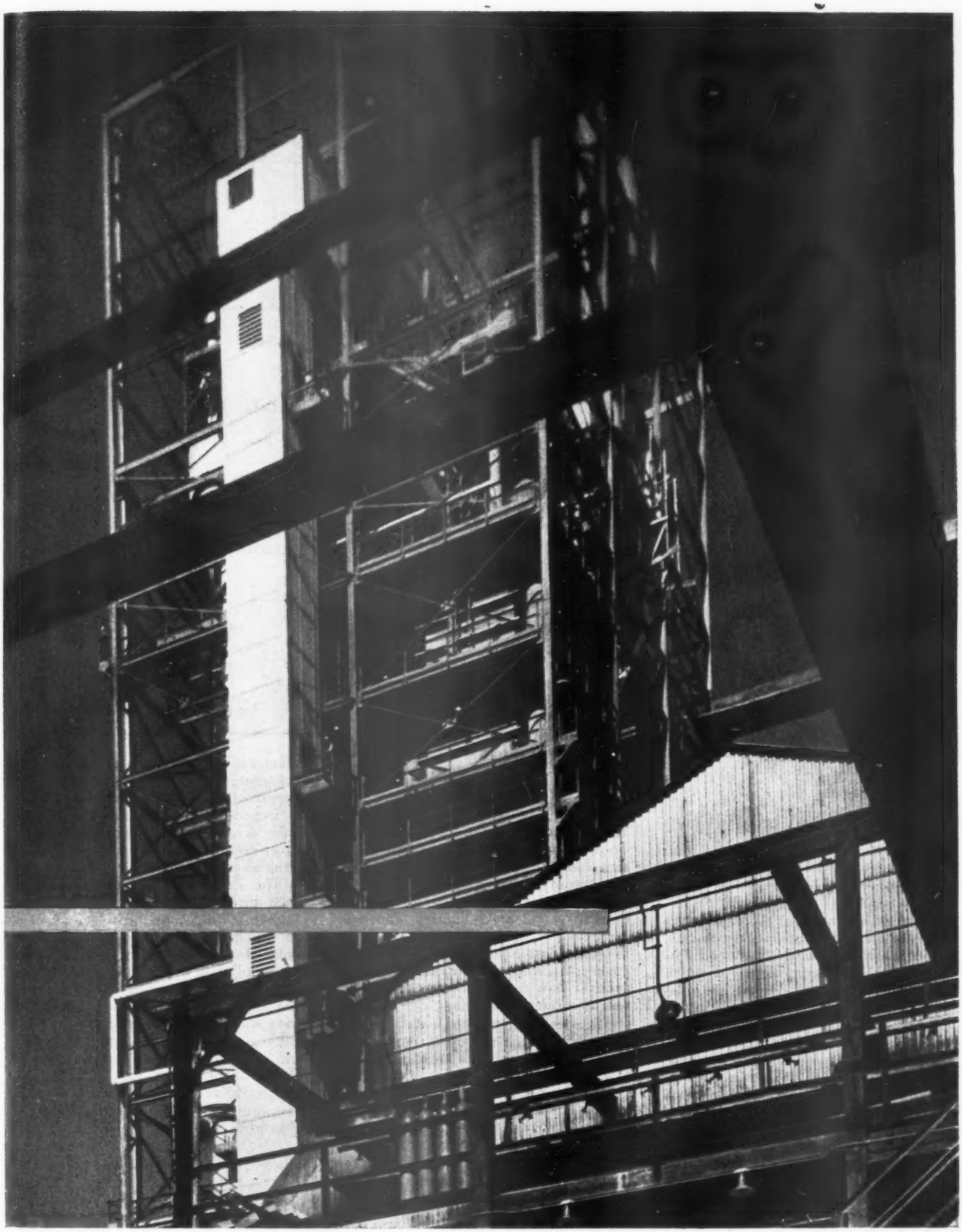

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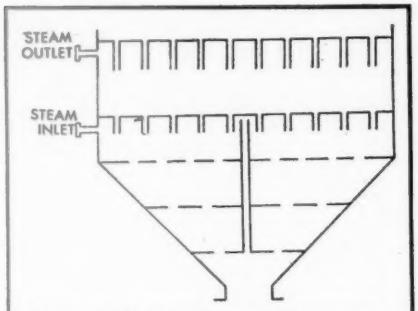


FIG. 9. TCC reactor purge zone.

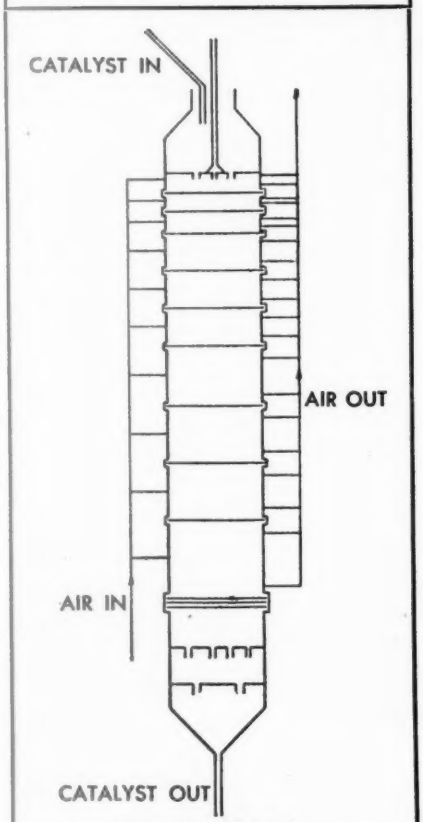


FIG. 10. TCC kiln.

(Continued from page 217)

and heat of hydration of the catalyst by steam. In a counter-current flow system, when the ratio of catalyst flow to oil flow is 2.0 or less, the temperature at which the catalyst enters the reactor has relatively little effect on the temperature of reaction, since heat is transformed from catalyst to gas extremely rapidly. In effect, raising the inlet catalyst temperature merely increases the temperature of the outgoing cracked oil vapors without any major effect on the reaction temperature.

Numerous studies of the heat transfer from gas to pellet catalyst have been made. A precise mathematical use of these data has been very difficult. However, it may be stated that the heat transfer is extremely rapid and is in general agreement with published results of similar studies. Following the correlation method adopted by Furnas,[2] the coefficient for heat transfer from gas to catalyst was found to vary from 0.003 to 0.013 cal. per sec. per °C. per cc., and the "material coefficient" A was found to be 0.05, which is well within the limits for various substances. Fig. 6 shows the experimental data together with a curve calculated from Furnas' data using $A = 0.05$. The only condition at which an appreciable difference between the temperature of the catalyst and hydrocarbon vapors can exist is at a location where the temperature gradient along the height is very steep.

It is interesting to note that the data show the absorption of 830 lb. per hr. of water by the catalyst, amounting to about ½ per cent of its weight. The specific heat of reaction for cracking varies widely for different operating conditions over the range of 90 to 200 B.t.u. per lb. of light products made. The figure used in the example is an average figure and gives the heat of absorption of water vapor as 1580 B.t.u. per lb. Obviously these two figures can be adjusted somewhat without affecting the heat balance. It should be mentioned again that these data are subject to the errors of commercial measurement, and are at present, the subject of additional study.

The heat balance on the kiln shows the endothermic heat of desorption, which is an aid in control of temperature in the top sections. The figure for steam generated, which is shown is the actual measured production. Apparently there is some as yet unknown heat loss in the system at this plant or the steam generation figure is in error.

Due to its complexity, the actual sectional heat balance for the kiln is not given, but the operating conditions, section by section, are shown in Table 2. Actual air flows and steam production figures for each section are unknown, but it is evident that the temperature rise on burning is a function of air distribution; and the temperature fall on cooling is a function of the number of cooling coils in service.

● **Mechanical design of plant reactor.** The cracking plant itself is simple in design and operation. The heaters, coolers, distillation equipment, and gas plant are conventional and common to many operations in petroleum refineries. The reactor vessel, shown in Fig. 7, is unique in the distribution of the oil vapors, the means of sealing the top and bottom, the catalyst flow control system at the bottom, and the purge system.

The clean regenerated catalyst is introduced into the reactor through a vertical leg, which provides sufficient head of catalyst to flow into the unit against the operating pressure. A top seal is provided by introducing flue gas into the catalyst distributing chamber under sufficient pressure to prevent hydrocarbon vapors from entering this zone and subsequently leaking out through feed leg. The flue gas is generally prepared in an inert gas generator, in order to have the minimum oxygen content. The distribution of catalyst over the catalyst bed is accomplished by a series of feed pipes, each covering about 10 sq. ft. of area. Uniform flow downward at this level is assured by the flow control system at the bottom of the vessel.

The oil distribution grid, shown schematically in Fig. 8, consists of inverted

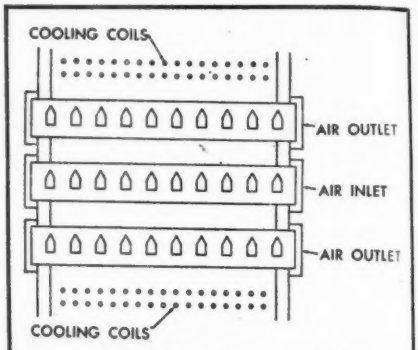


FIG. 11. TCC kiln—typical burning and cooling zone.

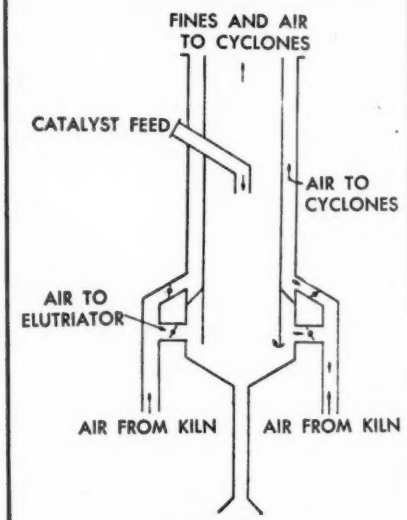
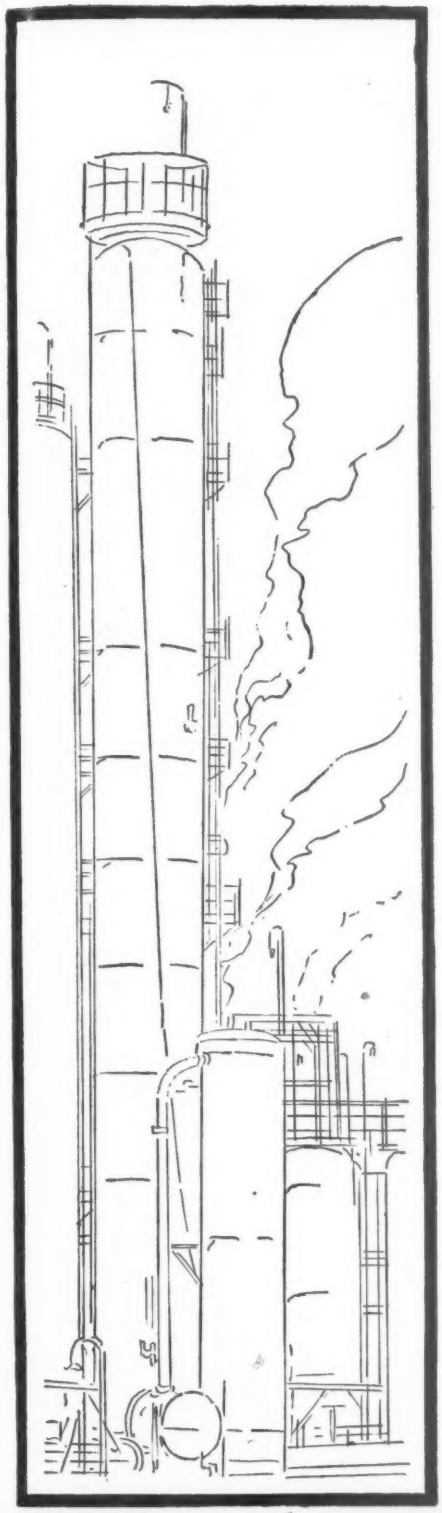


FIG. 12. TCC elutriator.

channels connected to an inlet duct passing along the diameter. The channels are constructed relatively narrow, so as not to impede catalyst flow, and at the same time deep enough to provide adequate cross section to avoid excessive pressure drop along the channel.

The catalyst, which passes over the feed grid, is coated with a deposit of higher boiling constituents of oil, some of which have been converted to a dry coke. However, cracking is still progressing, and it is essential to decrease the concentration of carbonaceous matter on the catalyst as much as possible. Not only would it be wasteful to admit into the regeneration zone spent catalyst having liquid oil on its surface, but an additional burning load would be imposed on the kiln. Furthermore, recovery of the "purge oil" amounts to several per cent of usable liquid oil.

Purging is apparently composed of two steps: Desorption of liquid oil from the catalyst, and sweeping of the oil vapors from around the catalyst particles. The time for purging is relatively short, and uniform distribution of steam is combined with the upper flow plate of the catalyst flow control system, as shown in Fig. 9. This flow plate contains several concentric rings of holes each four inches in diameter. The center to center distance along the circumference is short, and the distance between the pitch circles is about 18 in., which in-



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sures uniform catalyst flow at all points higher than about 27 in. above the plate. The catalyst collects beneath the plate according to its angle of repose leaving a vapor space for introducing the purge steam, and at the same time providing a seal and equalization of pressure across the cross section. This insures equal distribution of the purge steam to each of the 400 odd holes.

In some units, it is desirable to avoid steam in the active portion of the catalyst bed in order to obtain the greatest cracking severity. Hence, provision is made for collecting the steam and purged vapors in a grid of collecting channels of design similar to the oil distributing grid.

The catalyst flow plates have already been mentioned. In principle, the number of rings of holes is decreased at each succeeding lower plate. The center lines of the lower holes are midway btween the two circles above. Thus, the lower ring of holes collects catalyst equally from each of the two rows above, permitting a decrease in diameter to a single catalyst outlet. See Fig. 9.

The catalyst leaving the reactor passes through a depressuring pot, to allow the escape of steam which is removed by a small jet condenser. Inspection of the condensate stream for traces of oil provides a convenient check on the completeness of purge.

The temperature conditions in the reactor are such that a simple cylindrical steel vessel can be used, and the insulation placed outside the shell. The vessel can be fabricated in accordance with the API-ASME code in all respects. For corrosive stocks the reactor is lined with the proper alloy steel. This is accomplished with the minimum expenditure of expensive alloy. The elimination of heat insulation from within the reactor avoids the difficulty frequently encountered in this construction of coke formation within any porous material with subsequent uncontrollably high temperatures, in the event of air getting to the coke. This coke formation also tends to spall most refractories.

● **Kiln.** The design of the kiln has evolved after many years of study of clay burning and is based on commercial experience with percolation clay regenerators. This work has been described by Simpson, et al.[4] Numerous improvements and simplifications have been incorporated. The major of these changes is the elimination of angle packing and replacement of the salt cooling system with direct steam generating coils.

A sketch of a recent kiln is shown in Fig. 10. The distribution and control of flow of catalyst in the kiln is handled by the same designs as used in the reactor. The kiln is of square cross section in order to facilitate the entrance of the cooling coils. It is lined inside with a suspended tile lining (Dietrich or Bigelow-Liptak). This construction has proved quite satisfactory, since the kiln operation is at substantially atmospheric pressure, and the extensive use of buck-stays on the flat walls is not required.

No sealing of the top of the kiln is required, since the escaping flue gas from the top section is substantially oxygen-free.

The details of one zone in the kiln are shown in Fig. 11. One air inlet is used with two collectors. The minimum air path is about 30 in., which provides a pressure drop of a few inches of water through the catalyst. In the lower zones, longer holding time and longer air path are provided. The air inlet duct extends across the kiln and the distributor channels extend from the duct to the wall. As in the case of the oil inlet grid, of the reactor, the distributor channels are narrow and deep. Under normal flow conditions, there is a pressure change of 0.2 in. of water along the duct. While this pressure change is very small, it may be sufficient to affect slightly the air distribution, although perhaps not seriously if the absolute maximum burning efficiency is not required. In one of the latest commercial units where the coke to be burned was somewhat higher than for other units, an effort has been made to control the air flow over the section by inserting a pipe from the inlet duct to the center of the distributing channel. These pipes serve as limiting orifices, insuring equal air flow to each channel section; so that the air flow is substantially uniform over the entire cross section. Comparison of this unit with other ones not having this refinement will be very interesting.

At the exit of each burning zone is located a cooling coil or coils consisting of one or more banks of 2-in. coils on

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about 5-in. centers. The flow of water to these coils is arranged so that only those required to control temperature need be used. When a coil is cut off, the water is flushed out with steam to prevent excessive deposits of salt and scale. The usual method of installing the cooling tubes provides for free expansion, but minimizes any leaks of air in or fumes out of the kiln. The tubes are supported by tube sheets at the end and by a tube support resting on a beam of heat resisting steel in the center. The tubes are rolled into the front tube sheet, and all outside connections of water and steam are made from this end. However, the tubes are not rolled into the rear tube sheet, but are free to expand. The return bends are in a box at the "rear" of the tubes, and this box is gas tight, so there is no gas leakage to the outside, in spite of the floating fit of the tubes through this tube sheet.

The air to the kiln is furnished by two vertical ducts, and the fumes are taken away by two other vertical ducts. The flow is controlled by dampers in the ducts. Since there are two separate air inlet systems, it is possible to use one for hot and one for cold air, so that any combination which is desirable for proper control can be obtained.

Since a certain amount of attrition of the catalyst is unavoidable, and also because some catalyst must be removed and replaced with fresh catalyst in order to maintain proper activity, provision is made to remove the catalyst fines by elutriation. The elutriator is incorporated in the upper part of the kiln where a small stream of regenerated catalyst is diverted from the reactor feed to the elutriator. Spent regeneration fumes pass upward counter-current to the catalyst. Using gas velocities in the order of 17 feet per second, it has been possible to eliminate substantially completely all material finer than about 14 mesh. See Fig. 12.

Small catalytic unit

The Universal Oil Products Company has recently announced the invention of a small catalytic refining unit. The company has developed the compact unit that, it asserts, may revolutionize the petroleum industry.

Universal officials say that the new catalytic equipment can be installed at a low cost. It will also put the latest refining technique within the reach of all small refiners, officials of the company state.

● **Elevators.** The elevators are one of the important key units of the plant, and much study has been given to their mechanical design. The links are of low alloy steel and are designed to operate at temperatures up to 900°F.

The upper sprocket and head shafts are also designed for high temperature operation. The teeth of the sprockets are hard surfaced for satisfactory service with a minimum of lubrication. Experiments using a light volatile oil containing about 30 per cent of fine graphite for lubrication of the sprocket teeth have shown that the oil is vaporized without residue, and the layer of graphite effectively lubricates the teeth and chain. The head shaft is hollow and is water cooled. As a further precaution that the shaft is insulated between the sprockets, the main bearings are water cooled and lubricated by forced oil feed.

● **Conclusion.** The *TCC* reactor system is well suited to carrying out catalytic reactions of a vapor over a solid catalyst, in which the catalyst requires reactivation or regeneration. The system is flexible in that a wide variety of oil contact times and catalyst contact times may be used, and the regeneration can be appropriately controlled in a separate vessel. The engineering features of catalyst circulation, flow distribution, and sealing the reactor at pressures up to a few atmospheres have been worked out and proved commercially; and it is felt that this type of reactor system may well find use in fields other than the cracking of petroleum fractions.

● **Literature.**

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4. Simpson, T. P., Nicholls, E. S., and Payne, J. W., *Trans. Amer. Inst. Chem. Engrs.*, 36, 841 (1940).

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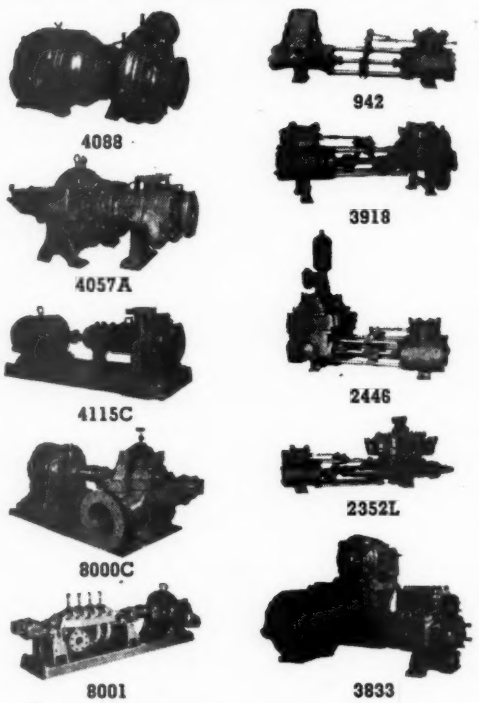

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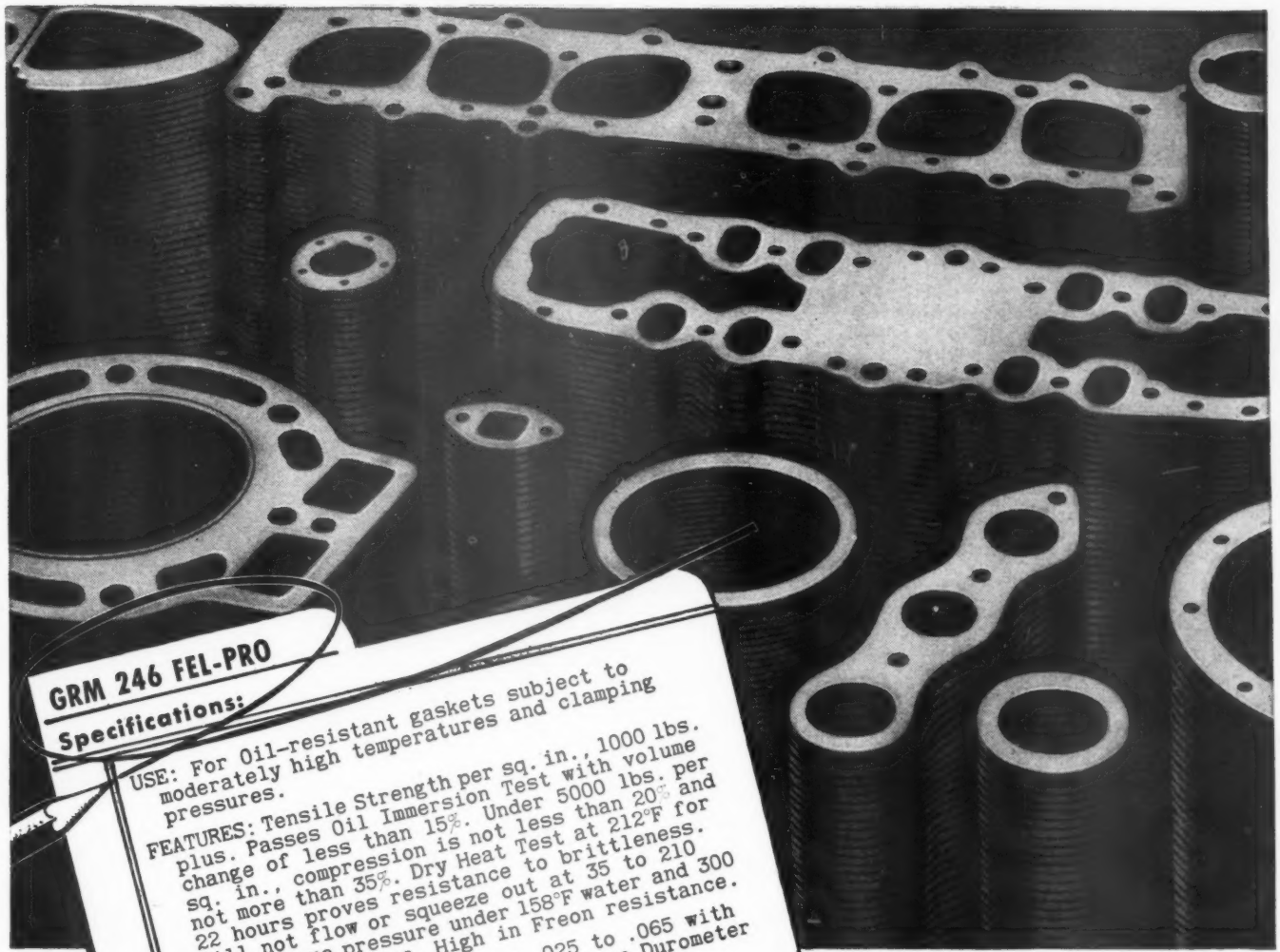
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New Pacific Coast high frequency laboratory

INDUCTION AND DIELECTRIC HEATING

JUST opened in Los Angeles by Westinghouse Electric Corporation is a high frequency laboratory, the function of which is to conduct researches in induction and dielectric heating, and to aid western industrialists in problems that might involve these phenomena. The laboratory, in charge of Dr. Russell A. Nielsen, is equipped with various pieces of apparatus by which it is possible to raise the temperature of substances and objects in a remarkably short time, and in a peculiarly localized manner that lends itself to many industrial applications.

Here one may see a 1-kw. generator fabricating plywood so effectively that when squeezed in a vise, the wood crumples but the joint remains unimpaired. As much as 24 hr. is usually required for setting by air drying, but high frequency heating does the job in a few seconds. Also demonstrated is a 5-kw. industrial radio frequency generator for dielectric heating, in which pellets of thermosetting plastic may be heated to approximately 275° F. and pressed into ashtrays in a matter of 30 sec.

A third machine—a 20-kw. industrial radio frequency generator—utilizes induction heating to process harden the cutting edges of mower blades, bringing them up to 1600° F. and dropping them into the quenching oil at the rate of one completed blade every 5 sec. Incidentally, only the cutting edges are heated, leaving the remainder strong and tough.

The so-called magic of induction and dielectric heating with alternating currents rests on two well-known and fairly simple electrical principles—simple as long as the explanations are confined to effects and not to what happens within the molecular structure.

The first is the principle of induced currents. That is, when any electrical conductor, magnetic or non-magnetic—in short, any metal—is surrounded by a coil carrying an alternating current, corresponding electric currents flow in the conducting metal itself. These currents, flowing against the electrical resistance of the conducting material, cause an energy dissipation within the material. This energy dissipation appears as heat in the same way that a lamp filament becomes white hot by the flow of current through it. This is the principle underlying a-c. induction heating.

Induction works fine for the heating of materials that conduct electricity, but it won't do for poor conductors of electricity, such as plastic, plywood, glue, paper, and arthritic joints. These materials are also heated by alternating currents (of higher frequency), but in a different way. An electrical condenser is made, consisting of a "sandwich" in which two metal plates or electrodes connected to the a-c. circuits are the slices of bread and the substance to be heated is the filling. Because this middle stuff to be heated is a poor electrical conductor—generally very poor—it is termed a dielectric, which gives to this second major division its name, dielectric heating.

Gets Heat Where Needed

Use of alternating currents for either induction or dielectric heating is simply a means of getting heat into a substance. There is no mystical benefit from the electric current. The heat, once it is established inside the material, is the same old finger-burning heat familiarly obtained with a gas flame or torch.

The salient feature of induction or dielectric heating is that it is the first time in history that we have a means of generating heat *inside* a substance (except by electric conduction and the limited and impractical method of heating obtainable by flexing or working the object). By all other methods—flame, hot liquid or gases, etc—the heat must flow in from the outer surface.

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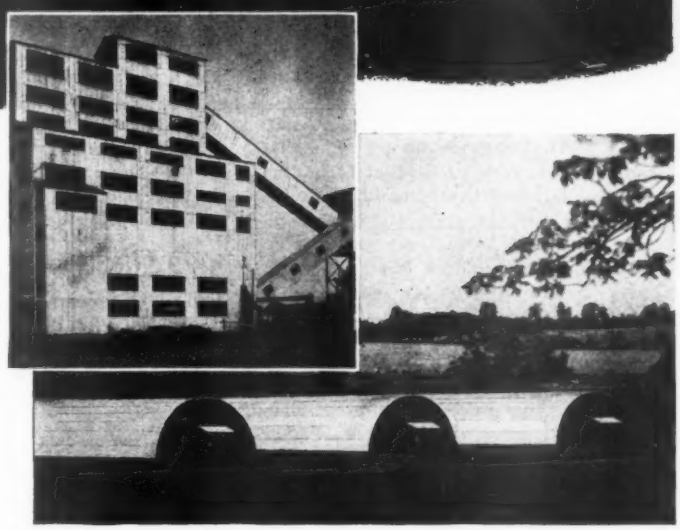

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at 2000° F. to a body at room temperature is only about three British thermal units per min. per sq. in. By induction heating, energy can be transferred to a piece of steel from 30 to 90 times faster with no difficulty, or at the high rate of 100 to 250 British thermal units per min. per sq. in.

From this ability of alternating current to develop heat within material stems many advantages of this form of heating. This is why so much is being heard about dielectric heating in connection with plywood and plastics. The marvelous new plywoods are made possible by superb synthetic glues. However, these synthetic binders are thermosetting; they set permanently when heated for a short time to not more than 350° F.

The thickest plywood that can be made using these superior binders and using the old methods of heat curing with steam platens is about an inch, because the heat must flow in from the outside. The outer layers reach the curing temperature long before the deep, inner layers get more than warm. The result is overcuring of the synthetic binder or scorching of the outer layers of wood.

If the heating is done more slowly, the time becomes uneconomically long, running into days or weeks; if it is hurried to save time the product is ruined. The same general principle holds for curing large blocks of plastic. Both plywood and plastics are poor conductors of heat, so that thickness becomes an obstacle if the heating must be done from the outside.

Heating with high frequency is a much different story. When plywood or plastic is made to act as the dielectric of a condenser—dielectric heating—the innermost layers or portion get hot as quickly as the outer parts. Except for mechanical limits, thickness doesn't matter. Plywoods made up of as many as 148 layers of birch veneer and measuring over a foot thick have been made using phenolic-resin adhesive and cured dielectrically in a few minutes. Many-layer plywoods made in this manner have tested tensile strengths of 45,000 lb. per sq. in., but weigh only half that of aluminum.

In evaluating induction and dielectric heating another advantage should be included—the ease of control, not remotely approached by any other heating method. The heating can be started or stopped instantly or made to vary according to any prescribed pattern. No preheating of a furnace is necessary; no excess heat is stored in any chamber or heating medium.

A-C. Heating Spectrum

In examining the frequency spectrum to see what bands are used for what, it is convenient to begin on familiar ground, with ordinary power frequencies of 50 or 60 cycles. Although a-c. heating is frequently thought of as being done at "high frequency," this is not always so. Power-system frequencies are used for induction heating of localized areas of metals for forging and upsetting. Where the metal is a good conductor and is quite

Demonstrating dielectric heating, Vernon C. Stanford uses radio waves to set thermosetting glue in 15 sec. instead of the usual 24 hr. Dr. Russell A. Neilsen, below, in charge of the laboratory, shows new techniques of induction heating.

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thick, and it is to be heated throughout, nothing is gained by going beyond power frequency, which is obviously the more economical power supply. Low-frequency induction heating may also prove useful for certain heat treating.

Because heating is relatively fast only a light, soft scale is formed. The virtual absence of scale, which is a hard abrasive, greatly extends the life of the forming punches and dies. Working conditions near induction heaters are better than around gas- or oil-fired furnaces as almost all the heat involved is generated directly in the charge piece. The only heat to which an operator is exposed is the heat radiated from the charge as it is removed for forging.

These low frequencies are also used to heat autoclaves and large chemical vats, the process being particularly useful where the absence of flame and fumes is an advantage. Work in the laboratory indicates that power frequencies can be used for drying various substances, such as large sections of formed heat insulation which is molded very wet, although in general drying dielectrically is not economical.

Most induction and all dielectric heating work, however, is being done at higher than commercial power frequencies. Leaving power-system frequencies and moving on up the spectrum, the engineer begins to make use of an important characteristic of alternating currents—skin effect. At the low frequency of 60 cycles the crowding of current to the surface of a conductor is relatively slight, but as the frequency increases skin effect becomes more and more marked. At a few thousand cycles virtually all the current flows in but a small fraction of the depth of a conductor. At ultra-high or radar frequencies, all current flows on the surface; the inside of a conductor could be removed, leaving only a thin shell, without affecting the current flow.

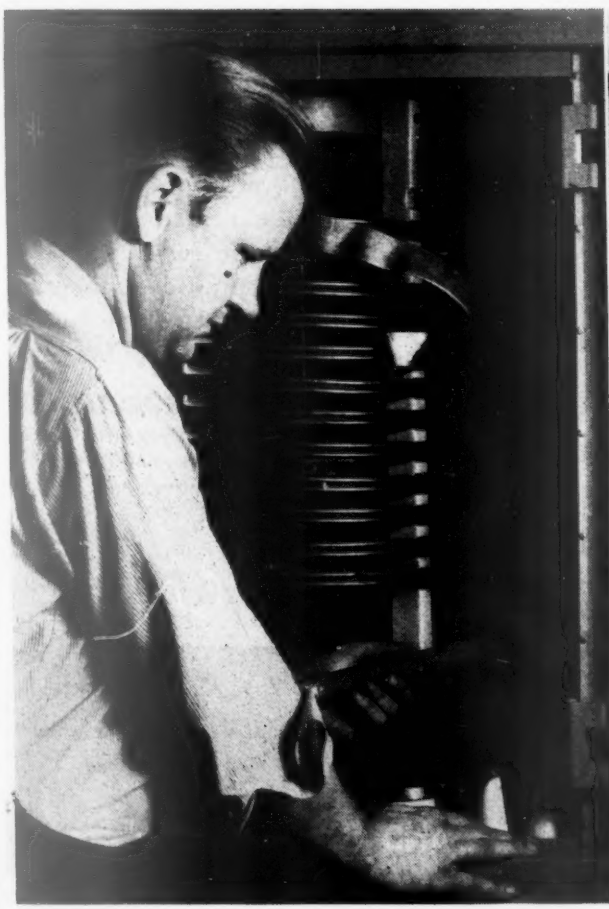
Skin effect, a headache to power engineers, is put to good use by the induction-heating experts. Extensive use is made of 3000 and 9600 cycles for surface hardening of metals and promising experimental work is being done at much higher frequencies. Consider a crankshaft with its many bearing surfaces. These surfaces should be just as hard as possible for minimum wear. But only these bearing areas should be hardened. The steel underneath and elsewhere throughout the crank must have maximum toughness. Needed then is a means of differential heat treating; a means of heat treatment for exact and limited portions of the shaft without affecting the interior of the metal or the other parts of the crankshaft.

For the induction engineer this differential heating is simple. A coil or collar, called an inductor, is placed around the bearing surface to be hardened, and current at several thousand cycles is passed through it. This induces high-frequency eddy currents in the crankshaft metal, but because of skin effect they crowd into the surface of the metal, just where the heating is wanted. The surface metal gets red hot quickly in a matter of perhaps two to ten seconds before the heat has time to wander off where it isn't wanted. When the correct hardening temperature is reached, the current is shut off, the hot surface is quenched in water or oil, providing a hardened crankshaft bearing surface. The job takes but a few seconds.

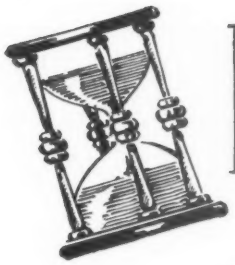
Induction heating is useful for differential hardening of internal surfaces as well as for exteriors. One company specializes in hardening internal surfaces, such as the walls of cylinders for internal-combustion engines, the interior of automobile hubs, and oil-well pipes. For this work the inductor coil of the right size and shape is placed within the object whose inner walls are to be hardened. Again using the principle of skin effect, currents are made to flow in the surfaces nearest the coil.

Induction hardening offers many production advantages—in fact, it is best adapted to high-production processes. Rocker-arm shafts for airplane engines are surface hardened in the areas on

E. H. Hulse stands before the oscillator coil as he prepares to install a grid resistor in a 20-kw. 450-kc. industrial radio frequency generator.



Inspecting a 10-kw. air-cooled radio tube is R. K. Collins. This tube is one of two in the industrial radio frequency generator installed in the Westinghouse laboratory at Los Angeles.



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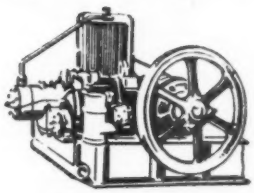

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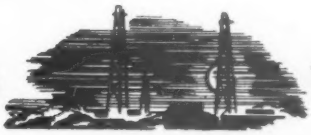

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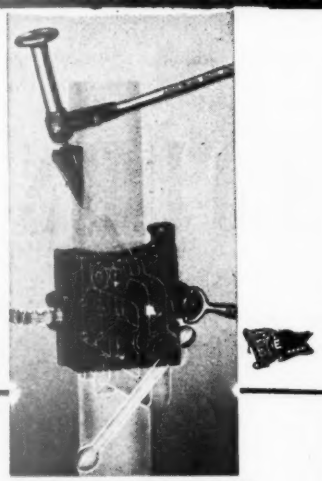

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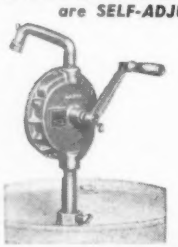

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Rings, liners, and casings can be heated for installation or removal by induction heating. This trick is being used to place tires over railroad-car wheels and for the insertion of gun liners. Shell casings are made of deep-drawn steel, in which the section to be drawn is inductively heated.

The frequency band between commercial frequencies and 15,000 cycles also includes induction melting. Most induction furnaces have been used for melting of small batches of steel, of not more than 5000 lb. per melt. Induction melting is used where an accurate composition of the finished product is needed, such as nickel-chrome alloys, certain tool steels, permanent-magnet alloys, etc. Most melting is done at 1000 cycles, although some is done on a small scale at 3000 cycles, and a few laboratory furnaces use 12,000 cycles.

Upper Induction Band

Electric power in the range between 100,000 and 450,000 cycles, which is just below broadcasting band, is supplied by electronic generators. These are being applied to a wide variety of induction-heating tasks. In this region skin effect in conducting substances becomes a prominent factor. The penetration is extremely shallow and the heating rapid. Thus, this frequency band is used where the heating must be done quickly in concentrated areas to avoid heat conduction to other parts, or where extremely shallow heating is needed. Also these frequencies are used where the parts are small—chisels or wrist pins, for example — and where the surface heating must be done quickly.

Outstanding example of this class of heating is that of flowing tin on electrolytically formed tin plate. Electrically deposited tin, although it saves from half to two-thirds of the tin, leaves the tin surface dull and porous. However, if the tin is heated just to the flow point, it refreezes with the desired hard, uniform, bright surface. This is accomplished by induction. The tinned steel strip is unwound at speeds up to 1000 feet per minute and passed through an inductor coil supplied with power at about 200,000 cycles. The tin reaches the flow point in a small fraction of a second and with almost equal speed refreezes as it is quenched.

Many other uses for the 100,000 to 450,000-cycle band are being found. An interesting and illustrative one is the hardening of rock bits used in the drilling of oil wells. Several of these bits on the end of a tool are lowered into the hole and rotated to bite their way through the rock to the oil-bearing sands. The harder the teeth the longer these bits stay sharp, i.e., the longer they can stay down on the job, which means less lost time in removing the string of rods from the hole. Heretofore, each tooth surface has been carbided by heating it individually to redness with a torch and sprinkling over it a layer of tungsten-carbide particles. To heat and harden the 20 teeth in this manner consumes the better part of an hour and requires a skilled torch operator.

In an induction-heating coil the job is done in a couple of minutes. The tungsten-carbide particles are held on the teeth by an adhesive, while the whole bit is brought to white heat by a 200,000-cycle field. All 20 teeth are carbided simultaneously and uniformly. Furthermore, this can readily be done in a protective atmosphere.

Soldering and Brazing

Soldering offers a big field for induction heating. A terminal block for airplane control wires has 30 connections to be soldered. Girls had been soldering these leads individually by hand, the job requiring about 15 min. A simple setup in the laboratory showed that all 30 points could be soldered simultaneously by induction in about 15 sec.

Spouts on metal cans such as contain lighter fluid, household lubricating oil, etc., are soldered inductively in about two seconds using a 300-kc oscillator. Such repetitive induction soldering lends itself to highspeed automatic, moving-belt methods.

Induction brazing is another comer. Most of this work is done near the upper end of the induction-heating spectrum, i.e., about 450,000 cycles. An expensive mold, for example, can be made by brazing in the induction furnace several simple parts instead of making the mold out of solid rock requiring expensive and difficult machinery. Super-hard cutting alloys can be tipped onto the supporting stock, by the induction process, in oxygen-free atmospheres.

In Ultra-high Frequencies

The field of dielectric heating is in the ultra-high frequencies — say from 2,000,000 cycles to upper limits yet unexplored. It is in the band from say 2 to 100 megacycles that so much in dielectric heating is being done. It is at these frequencies, for example, that the plywood and plastic curing methods mentioned earlier are being performed.

Dielectric heating is being used by the plastic industry not only for curing of plastics but also for preheating the plastic material before it is placed in the molds. Plastic preforms can be brought up to just below the curing temperature much more quickly, and what is important, much more uniformly by dielectric equipment. The gains have been significant. Mold wear is reduced, and the molding pressures, which strongly weigh on press cost, can be lowered by 25 to 40 per cent.

Lumber can be cured dielectrically, although this will not likely prove the most economical method of doing it in general. In the case of the more expensive woods, as for furniture or pianos, the storage and other facilities required for the two or three years needed for air dying can be reduced. Likewise, the waste factor and inventory charges are decreased. Drying of lumber in a few hours by electronic means is possible. It is simply a matter of economics.

★ ★ ★

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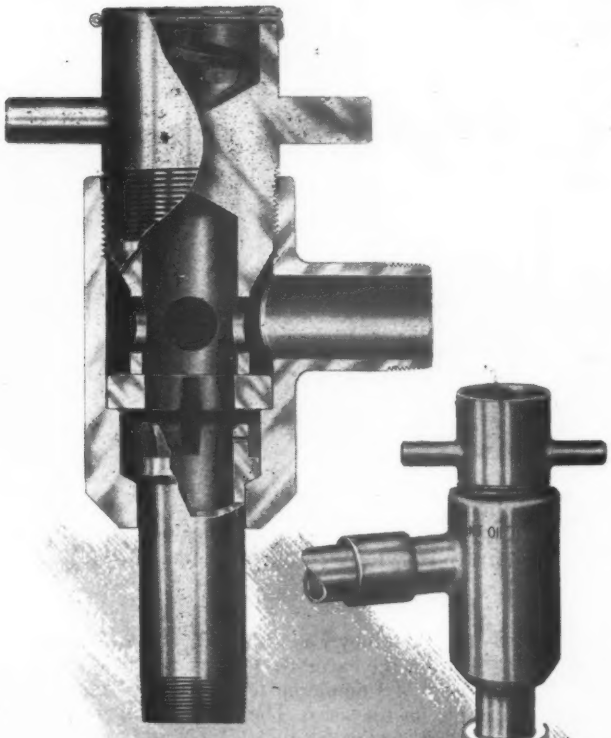
Production Pioneers Stage Gay 90's Barbecue

Bob Harcus of Byron Jackson runs into Percy Corey of the Indo-Burma Petroleum Company, one of the out-of-towners present. Bob is an old Burma Oil Company man himself.

OUT on the Murphy-Whittier picnic grounds of Standard Oil Company of California on Saturday, September 8, there foregathered in anything but solemn conclave some 350 Petroleum Production Pioneers, with torsos garbed in a weird assortment of costumes, and faces concealed behind lush and convolving fungus growth. The occasion was the annual barbecue of the Pioneers, and the raiment and hirsute adornments were what their wearers fondly believed to be the mode of the Gay Nineties. It was a colorful and entertaining affair in which the leading actors were Chef Pete Connor, expert barbecuist and his kitchen aides, and that distinguished bevy of barhops—George Trembley, Ted Forsyth, Hudson Drake and Lee Bushard, who dispensed lambent and luscious liquid with a lavish hand. Incidentally, in view of his consistently high class performance, Pete Connor was made Honorary Chef of the Production Pioneers.

As early as 2 o'clock the guests began to arrive and by 3, when the party was scheduled to begin, the congestion around

The call of the wild—come and get it!



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When excessive pressure is released the composition pressure release disc breaks into many small pieces which are washed out through the by-pass line. Since this disc is completely contained within the body there is no hazard from flying parts. Note, also, the bosses or cones on each side of the composition disc. This feature prevents the accidental installation of two or more discs at a time—a further valuable safety feature.

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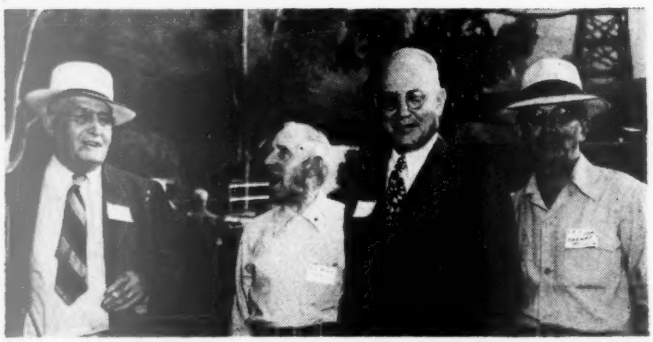
There are about 1000 years of oil experience represented by this group of old timers on the left. Top row: William Stroud, General Peeler, Billy McLaine, Neal Anderson, Dad Wilcox, Frank Hill, Lynn Little, H. H. Maddren and A. N. Other. Middle row: George Kenniston, Fred Ripley, John Peat, R. R. Smith, A. E. Fowks, Holly Hayter, Roy McLaughlin and Denny Driscoll. Bottom row: Frank Brayton, W. O. Todd, B. N. Youngken, W. M. Brown, Frank Dinger and John Grier.

Jack Smith and Lou Bronzan.



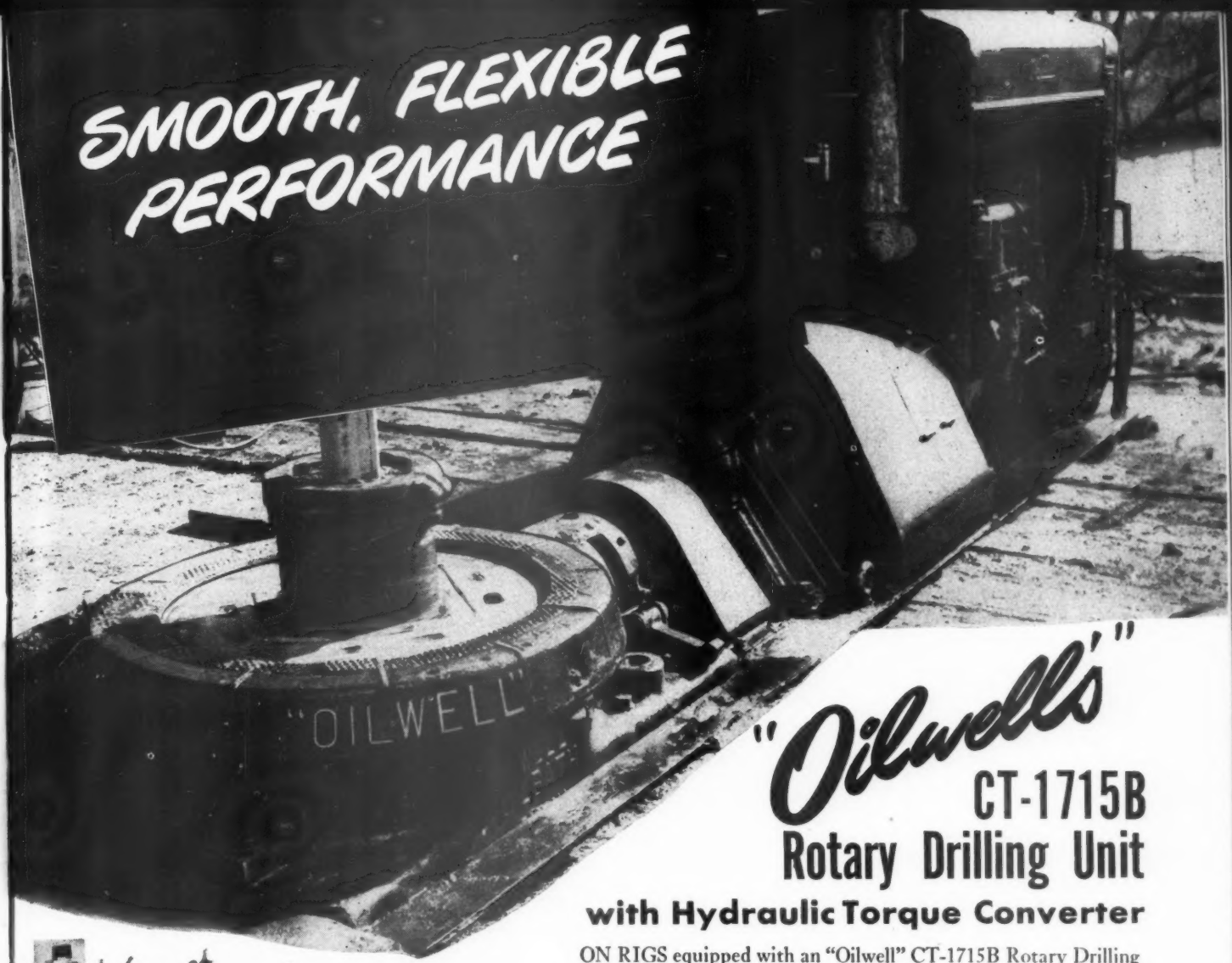
George Trembley was terrific. It was an ideal day—a stout haze had cut off the excessive heat that had been bothering the local Chamber of Commerce for some time, making life quite comfortable on the lease. The coughing of one-lunged gas engines furnished a slice of real Gay Nineties atmosphere that fitted admirably into the occasion. The costumes were colorful and varied, and to give the keynote to impromptu quartets, Ernie Fowks hired a group of yodelers, who, astounding as the fact may seem, knew more songs than Walt Greenfield and Ernie Adams combined—and what's more, sang them in tune.

The virtue of these Pioneer parties is that there is very little pre-arrangement. The old timers simply wander hither and yon, exchanging news and views with their erstwhile buddies and running into folks they haven't seen for thirty years. The September 8 gathering pretty well demonstrated once more that there is nothing they would rather do. There were scores of pioneers present, with an unbelievable wealth of history wrapped up in their breasts and an unquenchable desire to tell it to someone. There were many who have made substantial contributions to the development of the industry and many who are still making contributions. There was only one disturbing note in the whole program—that was the absence of Dick Guiberson who was to have officiated as master of ceremonies but was unable to be present. Dick suddenly found it necessary to have a surgeon do some exploratory drilling. However, we have since talked to him and are glad to report that everything is going along in good shape.

WHEN they weren't dealing with a piece of barbecued meat or wetting down a dusty thorax the Pioneers found plenty to talk about. These men who have spent most of their lives in the shadow of the derrick have much in common. Oil operation is a strenuous adventure and its vicissitudes have united the adventurers in a bond of comradeship and understanding that is long lasting and highly valued. These meetings merely provide an opportunity for the continuation of friendships that have been briefly interrupted by untoward circumstances, and they are obviously welcome affairs.

It was really good to wander around chatting with old timers like Lynn Little, Denny Driscoll, General Peeler, Frank Dinger, Ben Youngken, A. E. Fowks, Billy McLaine, Fred Ripley, John Peat, Holly Hayter, Roy McLaughlin, Mark Brown, and Frank Hill, who was quite recognizable despite his "forty-niner" disguise. There were many more who were worthy of special mention, some of them still active in field work and exchanging notes with others who held parallel positions many years ago. So interested did they become in their reminiscences that Prexy

Center, Bill Todd consorts with W. M. Brown, R. C. Stoner and C. J. McLaren, and, left, a couple of Gay Blades by the names of Ox Morgan and Jim Gosline



"Oilwell's" CT-1715B Rotary Drilling Unit

with Hydraulic Torque Converter

ON RIGS equipped with an "Oilwell" CT-1715B Rotary Drilling Unit, positive throttle control at the driller's position gives a wide selection of rotary speeds—with all the smoothness and flexibility of steam-engine performance. This not only assures more efficient operation of the drill string and rotary table, but also increases over-all rig capacity by releasing the full power of hoist engines for driving the slush pump.

Performance Features Include:

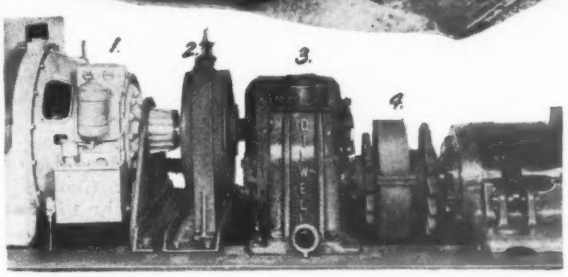
★ **VARIABLE ROTARY SPEEDS** controlled by engine throttle—no clutches, chain drives or fixed drawworks ratios.

★ **HYDRAULIC DRIVE** cushions the shocks of drill pipe in torsion—extending the life of drill pipe, rotary table and prime mover and reducing the danger of twist-offs.

★ **AUTOMATIC VACUUM BRAKE** stops and holds rotary table when engine runs at idling speed—facilitating the setting and removing of drill-pipe slips.

★ **IN EMERGENCIES,** (1) the hoist can be driven by the drilling-unit engine, (2) the rotary table can be operated from the hoist, or (3) in case of failure of hoist or hoisting engines, rotation of drill pipe can be maintained to prevent sticking.

Ask your nearest "Oilwell" representative — for complete specifications and detailed information on the "Oilwell" CT-1715B Rotary Drilling Unit—or arrange to see one under actual operating conditions.



This Ultra-Modern Unit provides a direct drive from an internal-combustion engine through a hydraulic torque converter and geared speed increaser or decreaser to an "Oilwell" 17½-inch Oilbath Rotary — all compactly assembled on steel skids for easy portability.

1. Torque Converter gives high torque at starting speeds and smooth, flexible power-flow at a multitude of operating speeds.

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4. Flexible Coupling has standby sprockets on each side (normally protected by guard) for emergency applications.

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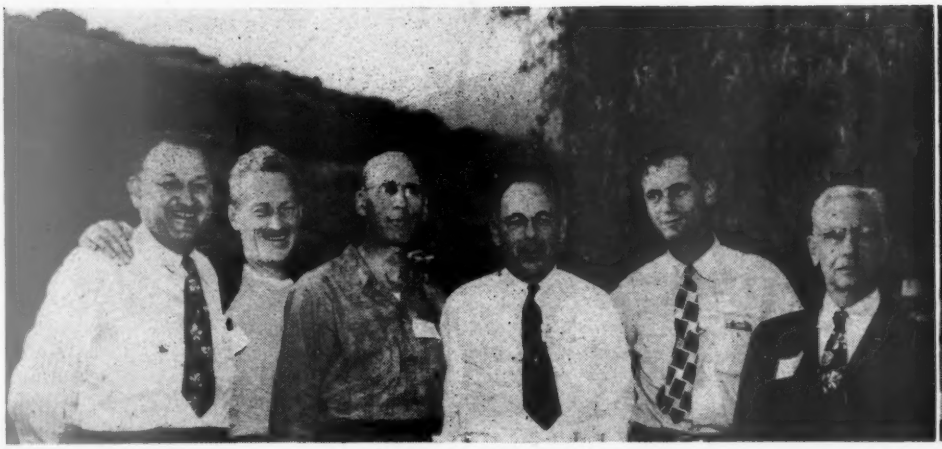
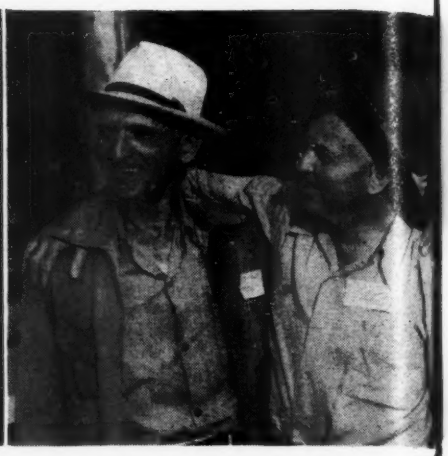




Left, Shell oilers Eli Peterson, Wally Gilbert, A. E. Collins, Seth Penfield, Russ Chambers and John Peat, retired; and right, Lynn Little, honorary president of the Pioneers and Roy McLaughlin, former California oil and gas supervisor.

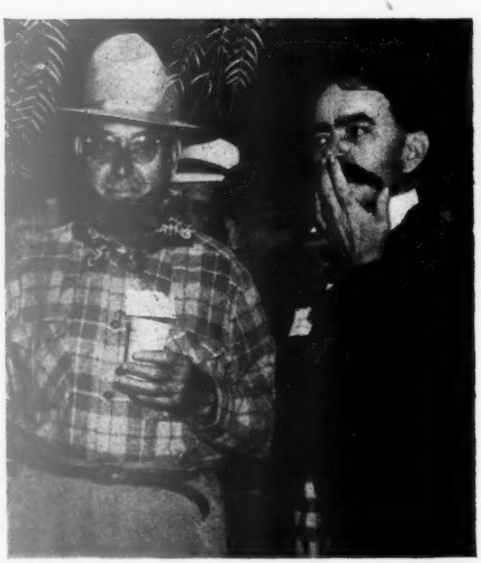
Henry Grinnell could hardly get them to sit down for dinner, and so thoroughly did they enjoy the dinner that he could hardly get them to rise up when it was over.

THERE is no question that the Pioneers' organization fills a definite need in the petroleum industry. Even without the Gay Nineties regalia, its parties are vivid and colorful to an unusual degree. This perhaps is because they are actually gatherings of two generations of oil men with similar interests and experiences, the only disparity being in the time element—which makes the meetings all the more exciting. The younger operators seem to get a real kick out of playing host to the older men and the latter very obviously enjoy being catered to.

Among the out-of-towners who attended were R. C. "Reg" Stoner, Jules Toussaint and Al Tietze of Standard Oil Company; Rudy Hartman, Union Oil Company, Orcutt; Early Deane, Texas operator; Pete Wallace of Drilling magazine, and Percy Corey, Indo-Burma Petroleum Company. Outstandingly arrayed was Ox Morgan, whose manly form was tastefully clad in a typical 1890 bathing suit, bearing across its middle this noble legend, "Save Your Kitchen Fat." Another high class exhibit was Jim Gosline's portrayel of a Barbary Coast saloon owner. Worthy of comment, also, were Tom Selzer, whose disguise has not been penetrated yet, Elmer Decker who appeared either as a kitchen helper or the proprietor of a delicatessen store, depending on your preference. Then there were Clarence Hill, Joe Siegel, Pete Erwin and many others all strikingly and becomingly attired in the gala duds of 1890 more or less.

It is hardly fair to pick out anyone for special mention. The entire proceedings had a pronounced Gay Nineties flavor; the day was crammed with interesting episode and event, and pioneers and juniors alike had a thoroughly enjoyable time.

Above, the famous Barbary Coast barhops—Lee Bushard, Hudson Drake, Ted Forsyth and the head bartender, George Trembley. Below, left, Pete Erwin adjusts his mustache while Frank Hill stands by. Below, right, in the cook's galley we have, left to right, Nick Nicodemus, Pete Connor, chef, Frank Hamer, Bill Manis, Joe Siegel, Bob Black, Frenchy LeClair, Art Butler, Tom Selzer, Pete Erwin and Seth Manning.



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THE DESIGN AND OPERATING FEATURES OF HOUDRY FIXED BED CATALYTIC CRACKING UNITS*

By **R. H. NEWTON** and **H. A. SHIMP**, Houdry Process Corporation

THE Houdry fixed bed catalytic cracking process was announced in 1938[1] and since that time several papers[2,3,4,5] have been published on the subject. These papers were concerned primarily with the refining aspects of the process, the economics of catalytic cracking, and the application to various refinery conditions.

The present paper is concerned principally with the distinctive features of design and operation that are novel in their application to petroleum engineering. Because of successful experience over a number of years, they should be of general interest to chemical engineers.

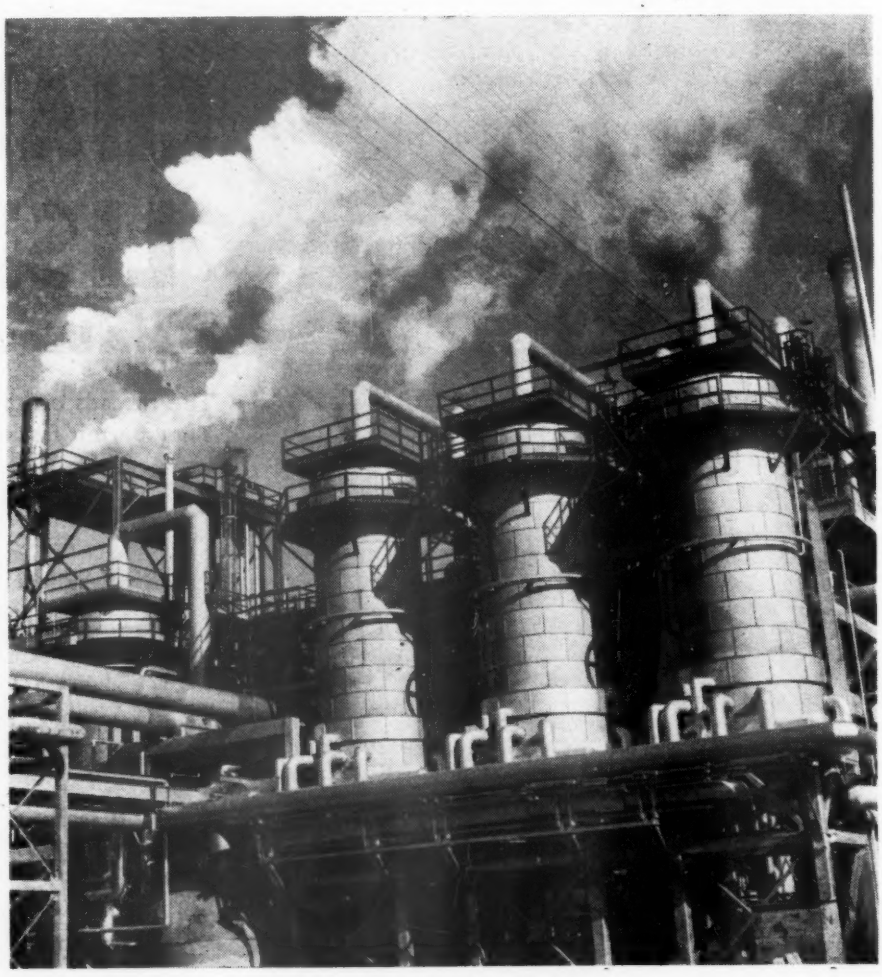
In the fixed bed plant, the catalyst in the form of small pellets is contained in specially designed heat transfer vessels or catalyst cases. The several gas streams are passed through each bed in sequence to obtain the steps of cracking, purging, regeneration and purging. The cracking step consists of passing the oil vapor over the clean catalyst, and is followed by the removal of adsorbed oil from the catalyst by purging with steam at low pressure. The regeneration of the catalyst is accomplished by combustion of the carbonaceous deposit with air and is followed by the removal of air and then the cycle is repeated. By the use of a number of catalyst cases, three or four multiples thereof, the flow of all major streams is continuous. These operations comprise the heart of the process. The heating and vaporization of the oil stream and the cooling, fractionation, and condensation of hydrocarbons follow the lines of conventional refinery processes. Fig. 1 represents a simplified flow diagram of a Houdry plant.

Catalytic cracking of petroleum fractions over silica-alumina catalyst is characterized by an endothermic reaction as the larger molecules are cracked, but is also accompanied by a deposition of heavy hydrocarbons on the catalyst, which ultimately build up to sufficient concentration markedly to decrease the rate of cracking. The method employed for regenerating the catalyst is combustion of the carbonaceous deposit, which is of course strongly exothermic. The heat of combustion generally exceeds the heat of cracking; so the entire process is exothermic. The alternate cycles of oil and air require efficient purging to avoid explosive mixtures. As in all catalytic processes, good distribution of the reacting vapors through the catalyst is essential. Thus the needs of catalytic cracking may be summarized as follows: furnish heat when and where required, remove heat during regeneration, purge catalyst to avoid mixture of air and oil streams, distribute reacting vapors uniformly over catalyst and prevent build-up of excessive catalyst deposit that hinders reaction. In order to achieve all these objectives at the same time, many factors of design were considered.

● **Cycle operation of plant.** Having settled on a fixed bed of catalyst, studies were made of the optimum type of cycle to use. The general picture of yield of gasoline is summarized in Fig. 2, which shows the relationship between the carbon deposit and the gasoline made when other conditions are adjusted to optimum. It is evident from this series of curves that a yield of gasoline obtained at about 4 per cent by weight of carbon deposit is not far from the economic maximum. One other factor not shown is the light gas production. These light gases are of interest only as refinery fuel in most cases and hence are of low value. As the oil is cracked deeper, the losses to coke and to light gas increase much more rapidly than the gasoline increases. Hence for most applications, the catalytic cracking unit should be designed to handle about 4 to 5 per cent of the charging stock as carbonaceous deposit to be burned from the catalyst.

With low activity catalysts that were available in the early days of the development, it was difficult to obtain the desired depth of cracking at high space rates. However, by the time the first commercial scale unit was ready to operate, the knowledge of catalyst was sufficiently advanced to permit high activity that would allow conversion of the order

General view of Houdry cracking unit. *Courtesy of Sun Oil Company.*



*Presented before American Institute of Chemical Engineers, St. Louis, Missouri, November 19-21, 1944. Published in *Transactions AICHE*, April, 1945.

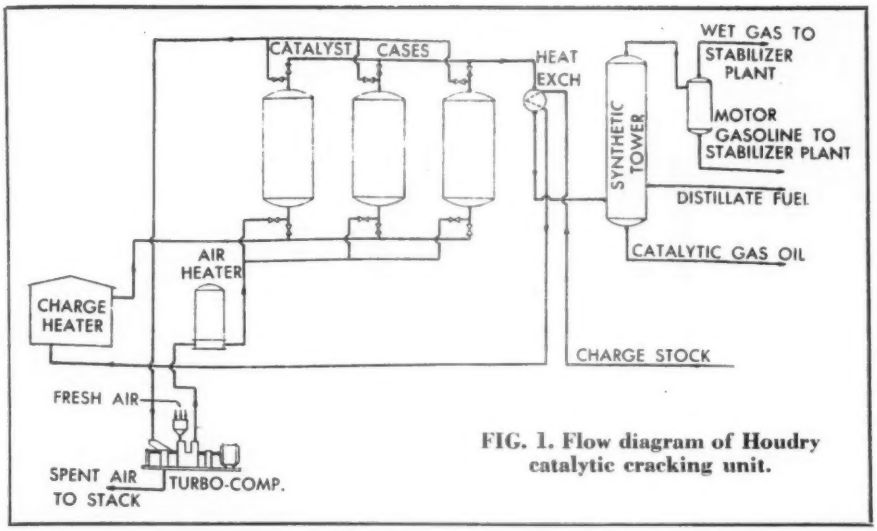


FIG. 1. Flow diagram of Houdry catalytic cracking unit.

TABLE 1

Cycle timer sequence

Open oil inlet and outlet valve	0 min. 12 sec.
On-stream	10 min. 8 sec.
Close oil valves	0 min. 12 sec.
Check closed	0 min. 8 sec.
Open evacuation valve	0 min. 14 sec.
Evacuate	3 min. 46 sec.
Steam is cut in when pressure reaches 15 in. Hg. abs.	
Close oil evacuation valve	0 min. 12 sec.
Check closed	0 min. 8 sec.
Open air repressure valve	0 min. 12 sec.
Repressure	1 min. 16 sec.
Open main air valves	0 min. 20 sec.
Regenerate	10 min. 8 sec.
Close main air valves	0 min. 12 sec.
Check closed	0 min. 2 sec.
Open air evacuation valve	0 min. 12 sec.
Evacuation	1 min. 24 sec.
Close air evacuation valve	0 min. 12 sec.
Check closed	0 min. 2 sec.
Open oil repressure valve	0 min. 12 sec.
Repressure	0 min. 48 sec.
Total	30 min. 0 sec.
Repeat cycle, open air valves, etc.	

given above, at space rates of 1 liquid volume of oil per volume of catalyst per hour and higher. This resulted in the necessity of burning carbon at the rate of 7.8 lb. per hr. for each 100 lb. of catalyst on stream. Obviously the use of multiple catalyst cases allowed considerable flexibility in design since for each case on stream one or more could be regenerated. If the condition is set that both oil and regeneration air flow are continuous, then the regeneration time must be an even fraction or multiple of the on-stream time, and a wide variety of cycles can be used.

The nature of the carbonaceous deposit is such that combustion takes place in a very narrow band (about 3 in. in width) and the temperature reached is a function of the carbon present, unless very low air flows are used. This latter case was found not to be interesting since the regeneration period was excessively long. In order to control the maximum burning temperature within the limit that would not damage the catalyst, it was found necessary to limit the amount of carbon on the catalyst and also provide extensive heat transfer surface for removal of heat. This combination with the heat capacity of the catalyst and heat transfer elements worked out to a carbon burning rate of 1.1 per cent by weight of the catalyst in 10 min. when the initial concentration did not appreciably exceed the 1.1 per cent. If the initial concentration were higher, and the burning allowed to proceed a longer time, excessive temperatures were found. On the other hand, if the initial concentration were lower, insufficient heat was developed (considering the heat removing capacity) to burn off the deposit cleanly; in other words, the fire went out.

A second factor in limiting the deposit on the catalyst was its poisoning effect. The rate of cracking on clean catalyst is very high and drops to practically zero when the catalyst deposit amounts to 13-18 per cent by weight. In order to promote a sufficient rate of cracking to attain the desired depth, the maximum deposit was found to be about 1.5 per cent.

Thus the general design condition was set up that at the end of the on stream period the catalyst would have a carbon deposit of 1.1 per cent by weight or 7 g. per l. of catalyst. Regeneration periods of less than 10 min. did not appear feasible, and since concentration of carbon was the major factor in the maximum temperature, a longer regeneration time represented a loss in carbon burning capacity.

FIG. 2. Typical product distribution.

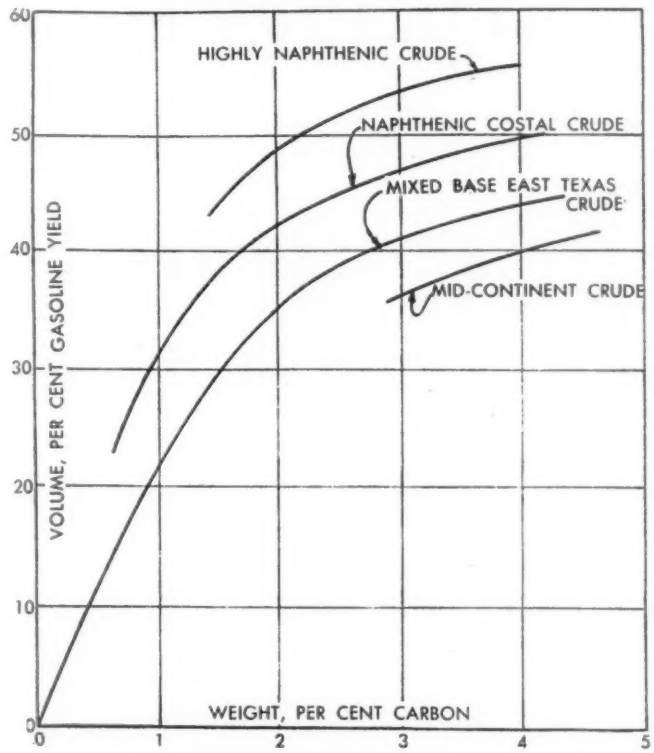
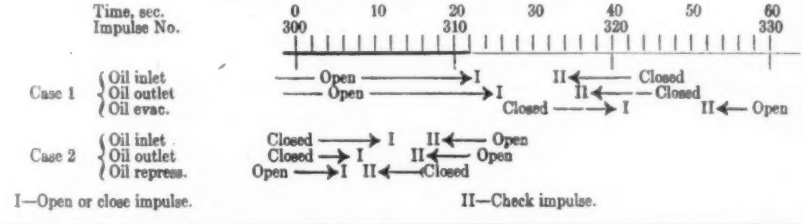


FIG. 3. Typical cycle time sequence.



A portion of a typical commercial cycle is shown in the chart, Fig. 3. A typical sequence is given in detail in Table 1.

The overlap of these operations is shown in the sequence diagram. It is evident that the flow of oil and air to the cases is continuous. It should be noted

(Continued on Page 246)

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Now small refiners can meet anticipated post-war octane requirements *with* catalytic cracking and *without* paying a penalty for the modest size of their operations. For Houdry has designed and engineered a small T C C unit (2000 b/d to 3000 b/d) which, through scientific simplification, will produce high octane gasoline as cheaply as much larger catalytic units.

The catalytic section of the small T C C unit illustrated is compact but complete. It includes all the essentials of cat crackers many times its size. And the simplifications which have been achieved in its design have not sacrificed efficiency. For example, there is only a *single elevator,* instead of two or three, and a common vessel serves as reactor and storage for hot catalyst.

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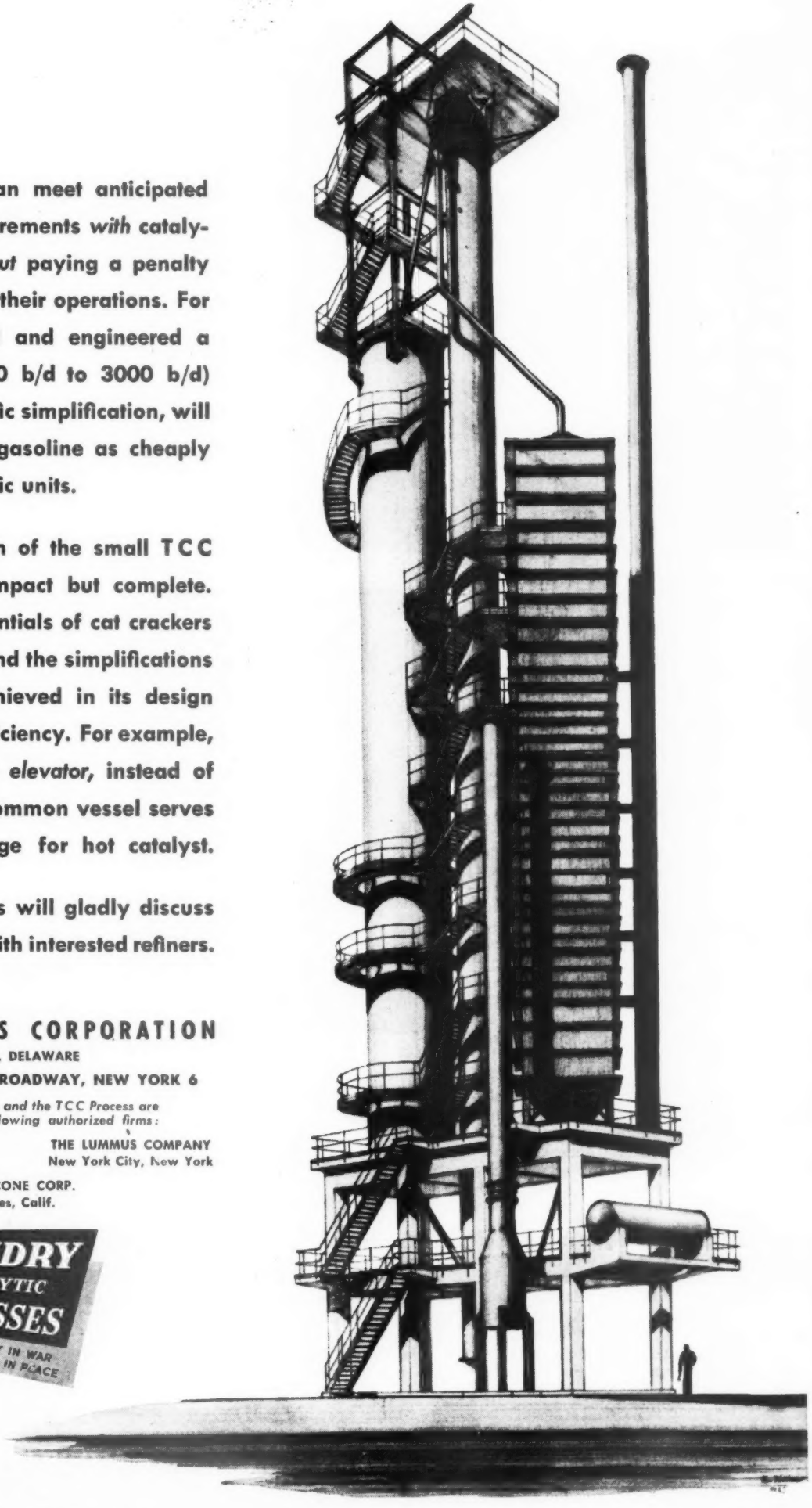


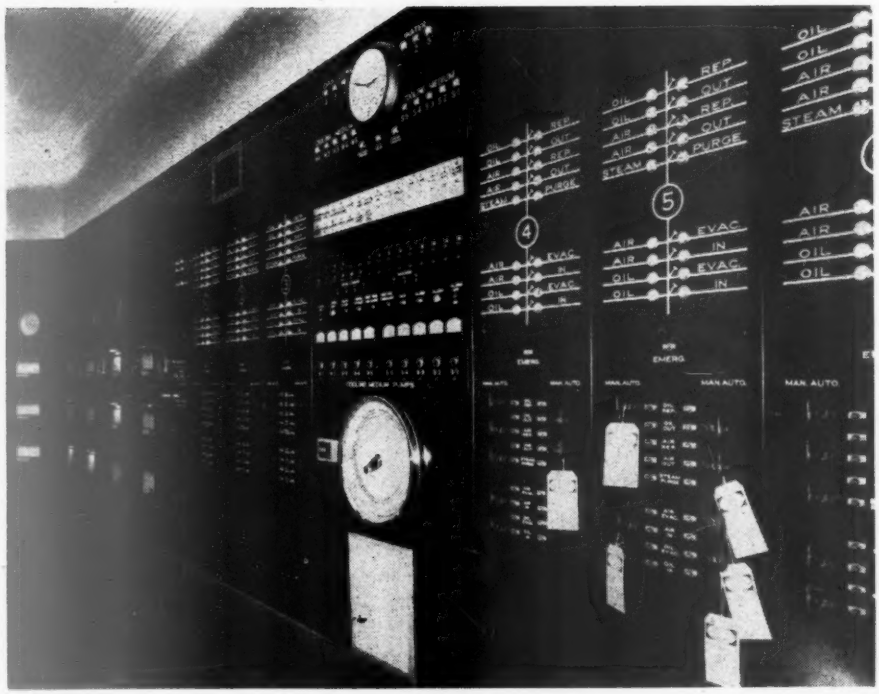


FIG. 4. Dial type cycle timer—front view. *Courtesy Sun Oil Company.*

(Continued from page 243)

that all important valve changes are checked before the next operation is started. In the event the check contact is not closed, the cycle timer is stopped automatically and an alarm warns the operator who then operates the cycle on the manual control until the difficulty is straightened out.

A second type of cycle that has been quite widely used in Houdry cracking plants differs from the above employing a regeneration period twice as long as the on-stream period. Four catalyst cases are involved in this cycle; one is always on stream, two are being regenerated, and the other is being purged. This type of cycle is adaptable to very short on-stream periods—as short as 7 min., 30 sec., since the cycle length here is determined by the minimum time for purging and valve changing, and not by the regeneration time as in the former case.

This same type of cycle control has been adapted to other processes, some of which have far more complicated cycles. It is evident that almost any sequence of operations that may be required can be obtained in a fixed bed catalytic process.

● **Cycle timer.** Two general types of cycle timer have been used. The front view of the dial type is shown in Fig. 4, showing again the cycle diagram (see Fig. 3). The rear view is shown in Fig. 5. There are 900 points of contact, arranged in five concentric circles, and the contact fingers wipe these pins to assure good contact. One impulse is made every 2 sec. The cycle is easily arranged and changed if desired by plugging in leads to the jacks of the contactor and the jacks of the master control board. The impulses are transmitted through relays

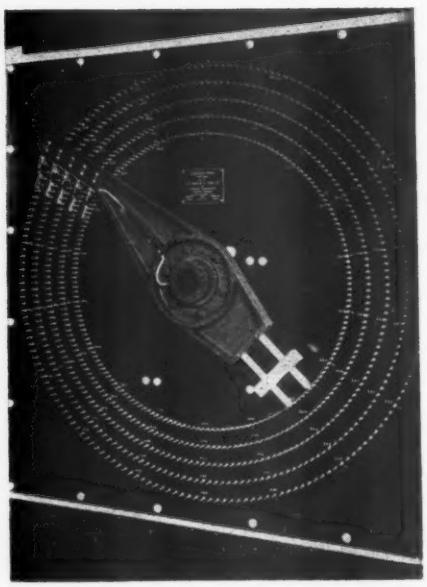


FIG. 5. Dial type cycle timer—rear view. *Courtesy Automatic Temperature Control Company.*

and through the interlock relays to the motor operated valves.

The second type of timer differs principally in the type of contactor. A picture of the jack type is shown in Fig. 6. The screw rotates at constant speed and is reversed at the end of each pass. Contact points are located in four lines and a wiping contact is made between the points and a bar located on a nut on the screw.

Both types of timer have been used for several years and have proved very trustworthy.

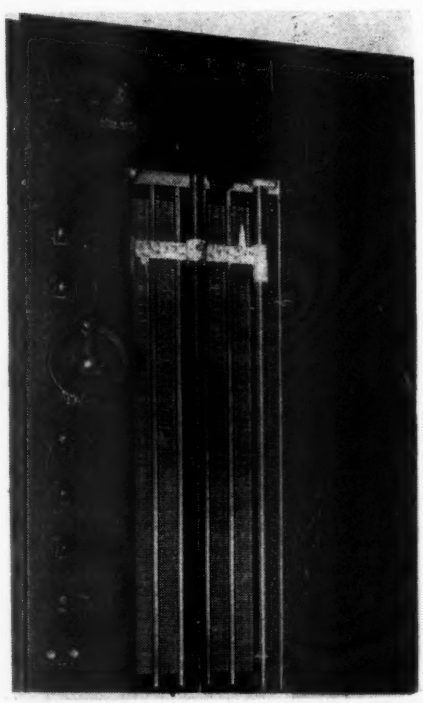
● **Motor operated valves.** A considerable study of various types of automatically operated valve was made to determine the most suitable construction for frequent operation at temperatures in the neighborhood of 850°F. Hydraulic or pneumatic valves were eliminated on the basis of their failure to positive closure. The type used is a forged steel body gate valve, motor operated with a double check on closure through a torque switch and a positioning switch. In emergency, the motor can be declutched and the valve operated by hand or the motor can be operated manually from push buttons in the control room. It has been found necessary to give very careful and continuous attention to the lubricants used to dampen properly the rotation of the shaft. Otherwise, it has been necessary to use magnetic brakes to lock the valve in closed position.

Since large size valves of this construction are quite costly, it has been desirable to install them with a venturi type contractor section, ahead of and a similar section of piping following the valve. In this way 16-in. valves have been used for pipe lines up to 30 in., and the permanent pressure loss at each valve has been negligible.

Another feature of the motor operated valves is the use of steam to seal the gate and prevent leakage of oil into air or vice versa. The valves are of the wedge gate type seating on both sides of the gate. The sealing steam is introduced at the valve bonnet and envelops the gate between the two seating surfaces. In order not to introduce an excessive amount of steam, as when the valve is open, the blocking steam is controlled by a pilot activated by operating mechanism of the main valve. The blocking steam pressure is set about 25 lb. per sq. in. higher than the highest operating pressure in the line.

● **Catalyst case design.** The design of the catalyst case itself is somewhat of a compromise since it has to serve several

FIG. 6. Jack type cycle timer—front view. *Courtesy General Electric Company.*



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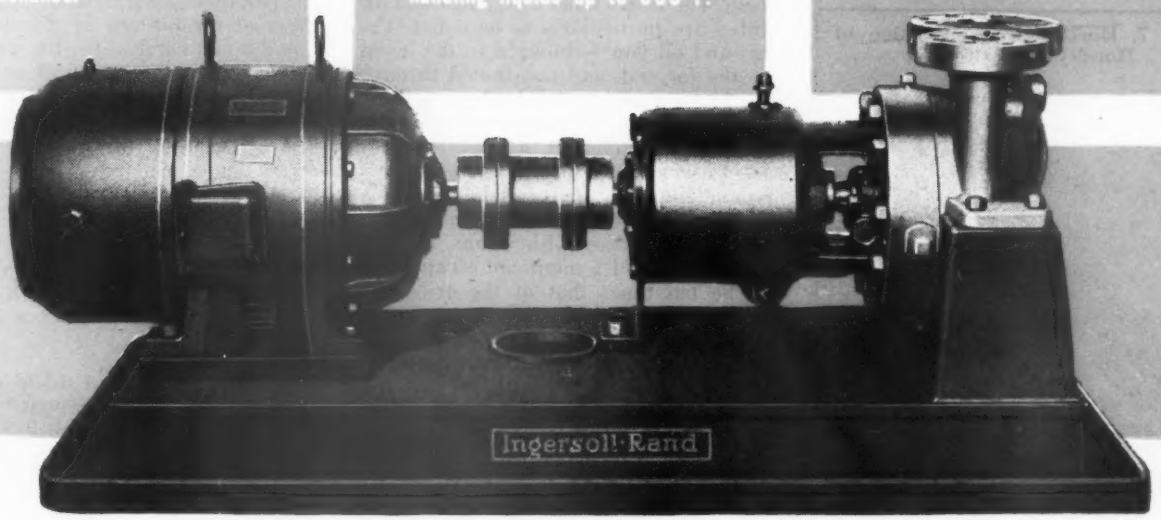

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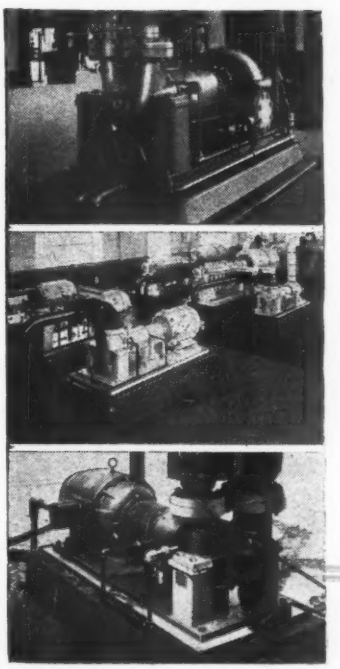

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functions. This description applies to the type of cracking cases now in use, although improved types are under laboratory and commercial study. Broadly speaking, cooling tubes for the circulation of cooling medium are embedded in the catalyst, and these tubes have heat transfer fins to increase the rate of heat removal. The oil and air are introduced through other tubes extending into the catalyst. Outlet and collecting ports are arranged so that the vapor path is about 30 in. This choice allows the use of the limiting orifice principle for insuring good flow distribution. The pressure drop through each set of distributor or collector bushings is about 13 in. of water or about six times the pressure drop through the bed. Thus any crushing of catalyst, or accumulation of fines in the bed has almost no effect on the vapor distribution.

FIG. 7. Horizontal cross-section of Houdry catalytic case.

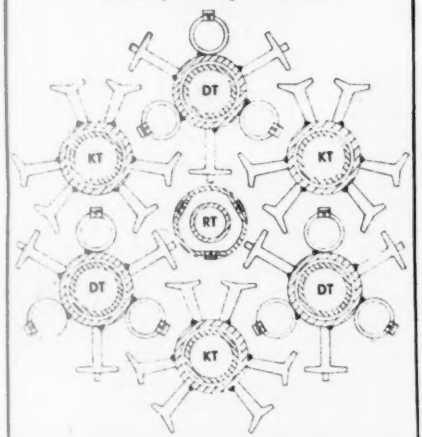
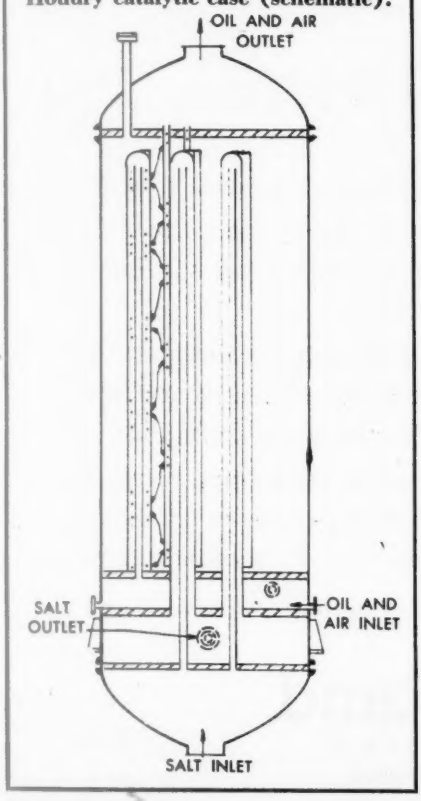


FIG. 8. Vertical cross-section of Houdry catalytic case (schematic).



A horizontal cross section of a portion of the tube pattern is shown in Fig. 7. The air and oil inlet tube or *RT* is not cooled by the circulating salt, but its temperature does not rise excessively because of the relatively cool vapors flowing through it. On the other hand the collector tubes or *DT* are welded to the salt cooled tube, which provides adequate cooling. In addition, there are finned tubes for cooling only or *KT*. The average distance between cooled surfaces is about $\frac{5}{8}$ in. Since the heat transfer from the steel tube to salt is very high—of the order of 300-400 B.t.u. per (hr.) (sq. ft.) (°F.)—and the external coefficient from gas and catalyst is limiting, the increase of external surface by the use of fins is very effective.

A simplified vertical cross-section of the case is given in Fig. 8 showing the flow of salt, and oil and/or air in the case. The insert tubes in the salt and air tubes are particularly to be noted. The air and oil flow is brought in the insert to the far end, and distributed through bushings of alloy steel. In order to keep these bushings from becoming plugged with a catalyst pellet, a shield of alloy steel covers the orifice. The escape area around the edge of this shield must be adequate to prevent excessive back pressure. In practice with 4-mm. catalyst pellets, we find a minimum escape area to be ten times that of the orifice. A typical bushing and shield arrangement is pictured in Fig. 9. The width of the escape slot is about $\frac{1}{3}$ the average pellet diameter. The flow up the insert and down the annulus results in equalizing the temperature along the tubes and in preventing hot spots. The transfer of heat from the external tube through the annulus to the inside fluid is controlled by relative flow rates and relative heat transfer areas.

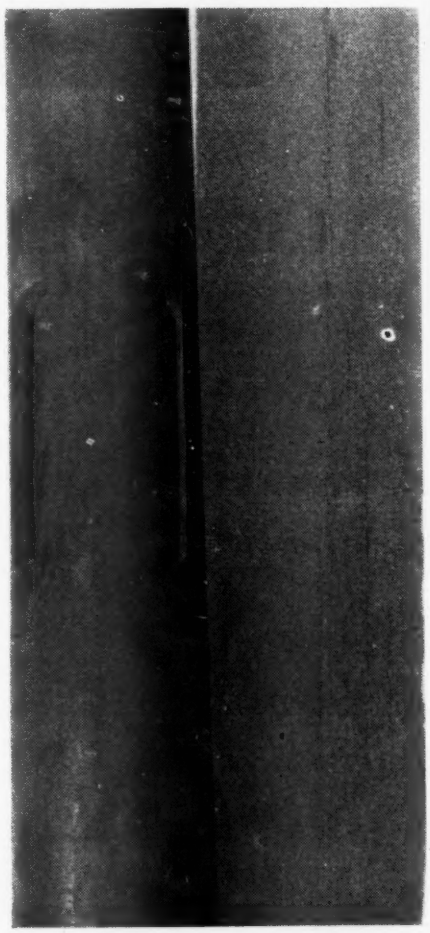
It should be noted that the finned sections are anchored at the bottom of the case. This is necessary because of the lifting action of the catalyst during the cyclic heating and cooling. The tube lifts slightly allowing catalyst to fall down and lock in the manner of a rachet. When the tube tends to slip downward again, the movement is impeded by the catalyst in compression. This causes considerable stress in the tubes and if they are anchored at the top only, gives such compressive stresses that the top tube sheet is ultimately deformed. By anchoring the tubes at the bottom, the stresses are tension, and are relieved at each cycle without bending or buckling of the tubes.

The necessity for salt flow in and out the bottom of the catalyst vessel together with the need for introduction of air at this point makes the construction of the bottom of the case somewhat complicated. Three header areas are provided; the upper between the catalyst tube sheet and the main tube sheet is for oil and is sealed from the case area by gaskets. The *RT* tubes are screwed into the catalyst tube sheet also and the other tubes are rolled into this tube sheet. These closures are not absolutely tight, but are sufficient for the seal between the oil inlet header and the oil catalyst space. However, between the salt header and oil header a positive closure is required. In this case the tubes are both rolled and welded, and the main tube sheet is welded to the shell. The construction of the bottom of the case is such that the second or main tube sheet takes the load, since there are fewer holes than in the top or catalyst tube sheet.

It is rather difficult to analyze in a simple manner the factors affecting heat transfer within the case. Fig. 10 shows the temperature pattern obtained when burning a deposit amounting to 7 g. of carbon per liter of catalyst—about 1.2 per cent by weight in 10 min. In this example the average temperature of catalyst at the midpoint between cooling fins is 917°F. over the regeneration period, and the salt temperature is 800°F. The external fin area amounts to 1.2 sq. ft. per liter of catalyst and the average heat of combustion of the deposit for one liter af catalyst for the cycle is 230 B.t.u. Of this, 79 B.t.u. is absorbed in the catalyst and steel fins by raising their average temperature. Thus an average overall heat transfer coefficient of 6.4 B.t.u. per (hr.) (sq. ft.) (°F.) is indicated.

If the entire cycle is considered the average catalyst temperature is 860°F., and there is no change in initial and final temperature. Deducting the heat of

FIG. 9. Typical shield and bushing arrangement.



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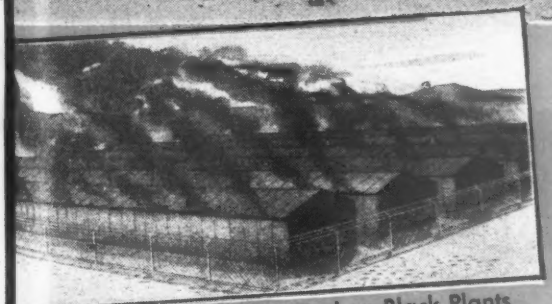

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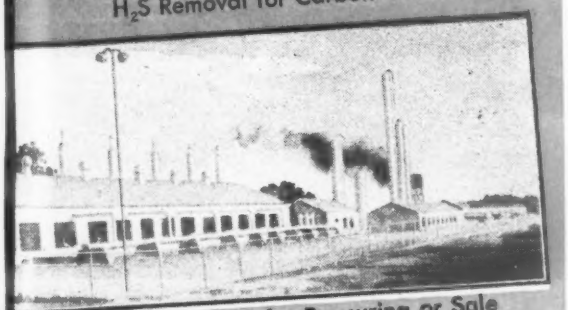

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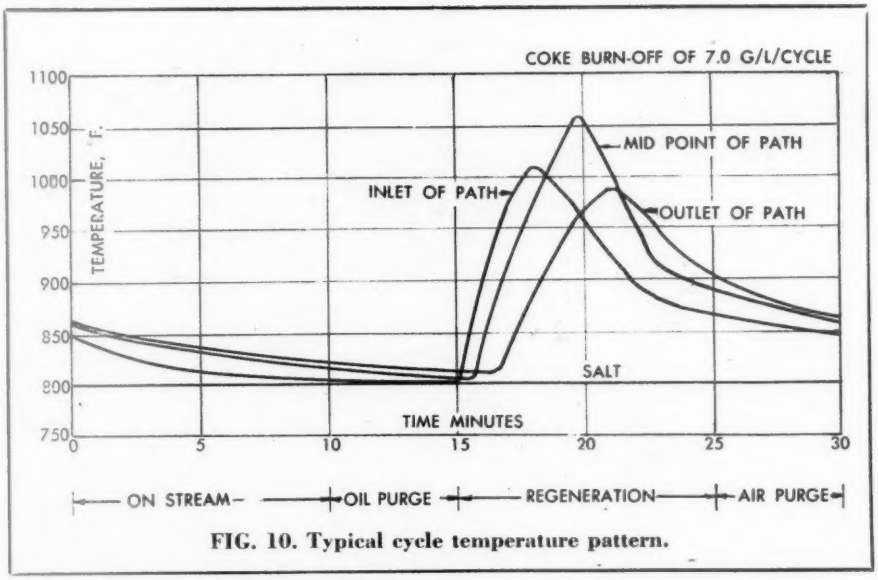


FIG. 10. Typical cycle temperature pattern.

cracking from the heat of combustion gives 213 B.t.u. per liter of catalyst for the cycle of 30 min. The calculated overall heat transfer coefficient for this case is 6.0 B.t.u. per (hr.) (sq. ft.) (°F.) of cooling area. This is made up of conduction from the pellets to the fins, convection between gas and the fins, and radiation from the pellets to the fins. No one of these is controlling for the conditions in commercial use at the present time.

The problem of temperature control at the border of the tube pattern has been solved by introducing a wavesheet or liner inside the actual shell. This liner corresponds closely to the external shape of the fined tubes and limits the amount of catalyst in this area. The limitation of the catalyst controls the carbon so that the heat to be removed is in proper ratio to the salt cooling surfaces. In other words the liner which is uncooled is substantially at a neutral point in the temperature cross section. The liner is made gas-tight except at the top, and the space between the liner and the shell is filled with Johns-Manville C-3 high temperature insulation. Care is taken that there is no vapor path through the insulation and that this area is evacuated with the case interior so that bulging of the wave sheet due to external pressure is avoided.

As a further protection against damage to the case shell, cooling coils are usually provided through which salt is circulated. This serves to provide cooling in the event it is required, and also maintains the area between the shell and liner above the dew point of the hydrocarbons, and prevents condensation in the insulation. Such condensation might lead to coke formation and very high localized temperatures during the regeneration period.

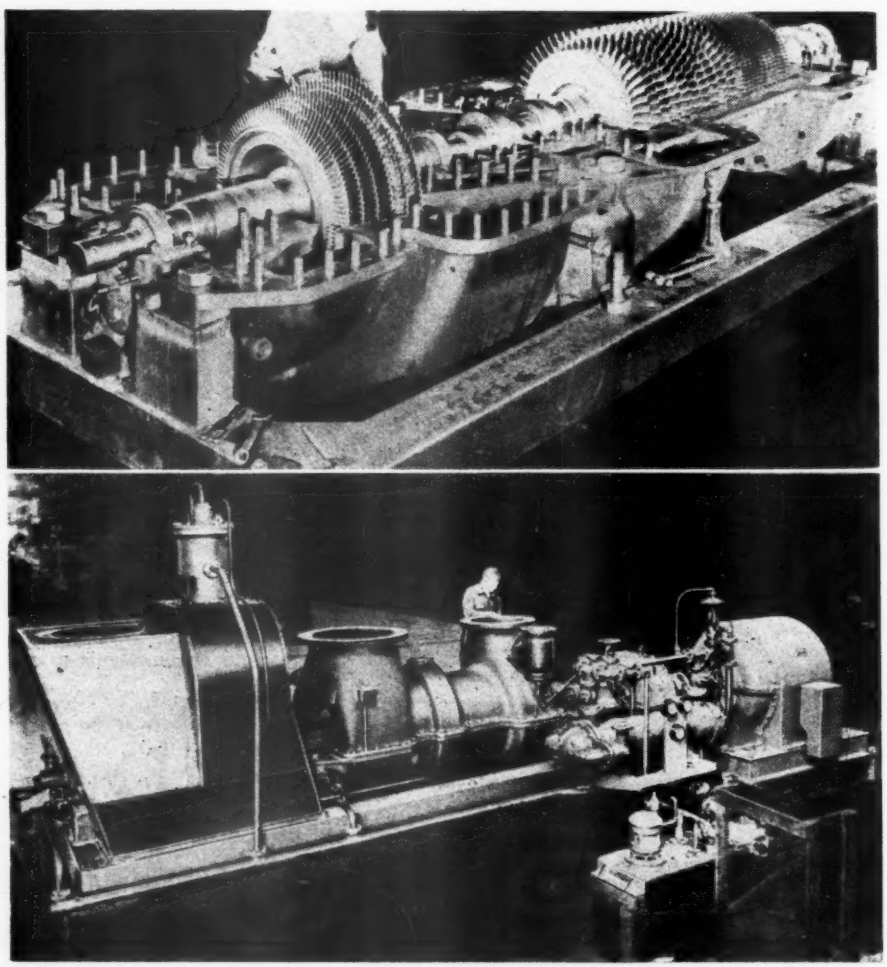
● **Salt cooling systems.** It is essential that temperatures be closely controlled in the catalyst bed, not only from the standpoint of excessively high temperatures, but also to prevent excessive cooling, which would cause condensation of liquid oil on the catalyst and lead to trouble in purging and regeneration. Hence the use of water as a cooling medium was abandoned because it tended to produce cold spots in the catalyst bed. The choice of the cooling medium eliminated organic compounds because of their instability at temperatures of 800° F. and above and finally narrowed down to a molten eutectic mixture of KNO_3 and $NaNO_2$. It has a conveniently low melting point of 284°F. and is stable in the absence of air. The heat transfer coefficients between steel and salt are very good and the salt is non-corrosive toward carbon steel below 900°F. For higher temperatures Calorized or alloy piping is satisfactory.

Because of the composition of the cooling medium, some hazard is introduced if oil and salt become mixed. However, at operating temperatures, the hydrocarbon vapors burn rather than explode, and with proper precautions no difficulties have been encountered.

The use of this high temperature heat control medium allows the introduction of heat into the catalyst at some portion of the cycle if desired. Also, the high temperature at which it is available and the excellent heat transfer characteristics are very useful in heating the regeneration air and in generation of high pressure steam.

The requirement to prevent oxidation of the salt and also to mimimize the hazard of accidental intermixing of salt and oil has presented some special design problems. The salt circulating through the cases is maintained under vacuum to remove any vapors given off and prevent vapor lock in the salt tubes of the case. The vacuum also serves to insure that, in the event of a salt leak, hydrocarbon vapors are drawn into the salt stream, and there is no possibility of salt leaking onto the catalyst, which may be saturated with heavy oil and

FIG. 11. Turbo compressor. *Courtesy Allis Chalmers Manufacturing Company.*



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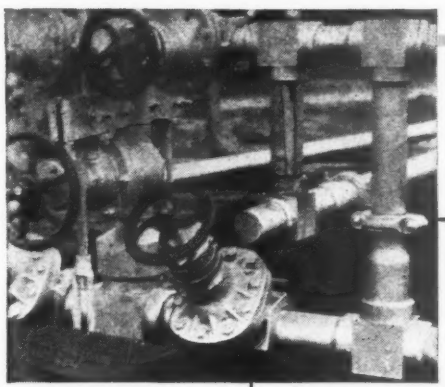

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TABLE 2

Typical heat balance over Houdry fixed bed cracking process.

	Heat input		Heat output	
	B.t.u. per hr.	Per cent	B.t.u. per hr.	Per cent
Combustion of coke	102,150,000	100.0		
Heat removal by radiation			5,000,000	4.9
Heat removal by regeneration fumes			3,015,000	3.0
Heat removal by oil vapors			2,360,000	2.3
Heat removal by heat of cracking			6,898,000	6.7
Heat removal by salt exchange				
to regeneration air			14,730,000	14.4
to steam production			70,147,000	68.7
Total	102,150,000	100.0	102,150,000	100.0

coated with carbon and thus represents a real explosion hazard. By sampling the gases removed by the salt evacuation system, any leak of oil can be instantly detected, and the offending case removed from service for repair. For this check, a portion of the evacuation gas is bubbled through water to condense any oil, which shows up as a film on the surface of the water.

Air is excluded from the storage tanks by a blanket of steam to prevent oxidation. When oil leaks are avoided there is no build up of carbonate in the salt, and the rate of oxidation is very slow, so that no treatment of the salt is required. However, accidents do happen, and a number of plants have installed equipment to recondition the salt by removal of carbonate and the reduction of nitrates to nitrite using hydrogen.

The salt system not only serves to cool the catalyst cases, but also provides an excellent source of high temperature heating fluid. It is commonly used for production of 450 lb. per sq. in. steam and for heating the regeneration air to reaction temperature. In some plants, the salt is used for raising the temperature of various oil streams as well. The heat transfer coefficients for various types of equipment using salt as a heating medium are as follows:

Type	U, B.t.u. per hr. (sq. ft.) (°F.)
Salt boiler	
liquid—boiling liquid	150
Steam superheater	
liquid—vapor	70
Air heater	
liquid—gas	5.7
Crude exchanger	
liquid—liquid	52-80

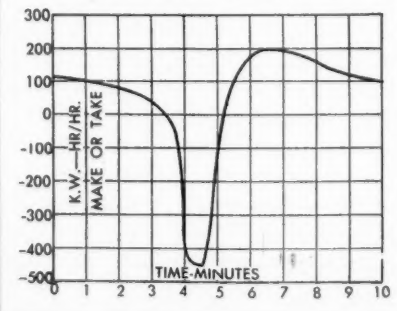
● **Power recovery.** One of the most interesting aspects of the Houdry fixed bed plant to an engineer is the application of a gas turbine to power recovery. In the development of the short cycles, which were desirable to provide the desired severity of cracking, it was found that regeneration under pressure was mandatory. The minimum pressure of operation

TABLE 3

Typical material balance.

	Bbl. per day	Per cent volume	Per cent weight
Cracking case charge	10,000	100.0	100.0
Cracking case balance			
Synthetic crude (to tower directly)			89.2
Synthetic crude (to oil evac. system)			5.5
Coke			5.3
Total			100.0
Products breakdown			
Motor gasoline	4,520	48.0	41.0
Cracked gas oil	3,760	37.6	38.8
Fuel gas			14.9
Coke			5.3
Total	8,280	85.6	100.0

FIG. 12. Typical net power output curve of turbo-compressor.



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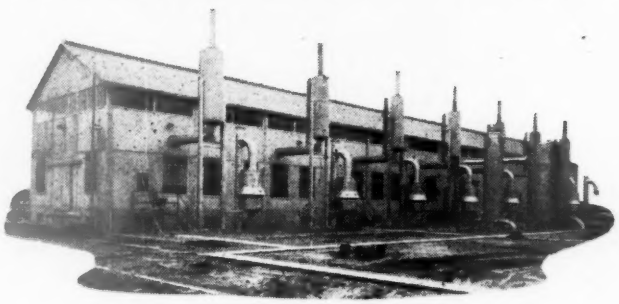

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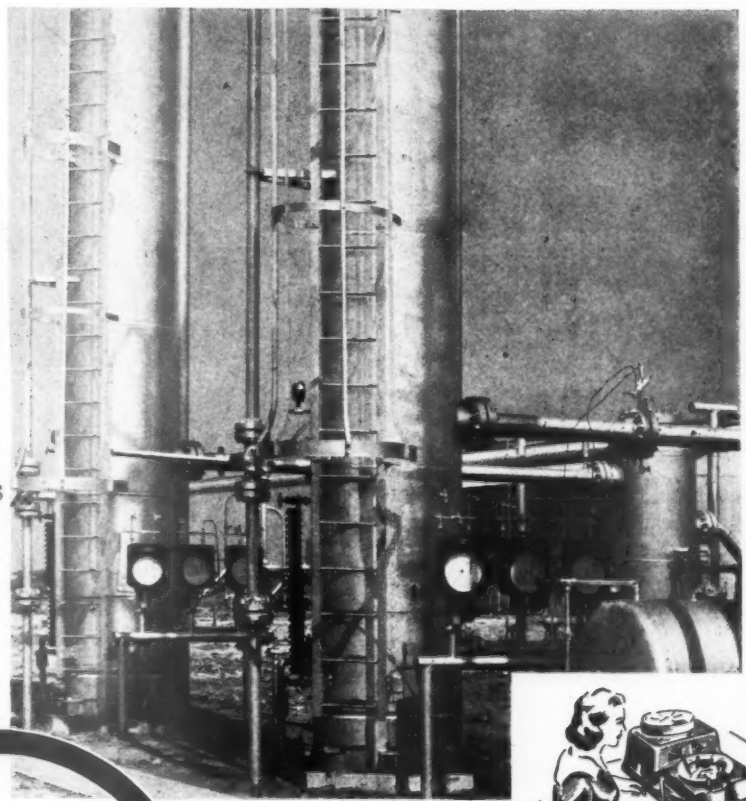

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required for efficient combustion was found to be about 30 lb. per sq. in. gage. However, for more efficient turbo-compressor operation, somewhat higher pressure was desirable.

Two views of the turbo-compressor unit are shown in Fig. 11. It is an axial type machine, equipped with low-alloy turbine blades and suitable for inlet gas temperatures up to 925°F. Machines having capacities of 16,000, 23,000, 40,000 and 60,000 cu. ft. per min. are now in service. The speed of the 40,000-cu. ft. per min. machine is 5280 r.p.m.

The power recovery cycle is complicated by the requirement of "stealing" from the compressor discharge the air to repressure the cases prior to regeneration. The fumes from the pressure release at the end of regeneration are not passed through the turbine. Thus, for a typical plant the power balance figures are as follows:

Theoretical power for compression —41,900 CRM @ 86°F. and —6.2 in H_2O to 53.3 lb./sq. in. gage and 433°F. = 4410 kw.
(Temperature efficiency = 87.0%)
Theoretical power from expansion of all the above fumes from 44.2 lb./sq. in. gage and 825°F. to atm. and 500°F. = 4800 kw.
(Temperature efficiency = 82.7%)
Theoretical net power generation . . . . . = 390 kw.

The mechanical efficiency of the compressor and turbine is high; the loss amounts to about 2 per cent on each unit. Hence the net power generation during the period of steady flow is 206 kw. The power deficit caused by withdrawal of high pressure air for repressuring amounts 450 kw. over a period of 1 min., 30 sec. Hence the average continuous loss is 68 kw. and the net mechanical power delivered to the generator is 138 kw. In an actual test operation of several weeks, the average net electrical power output was 120 kw.

The role of motor generator unit is illustrated in typical power output curve shown in Fig. 12. The requirement for furnishing energy during the repressuring operation is clearly shown.

● **Heat balance.** The heat balance for the catalytic section of the Houdry cracking unit is given in Table 2.

The system under consideration includes only the catalyst case area. Oil is supplied to this area as vapor at 806° F. and the regeneration air is introduced at 768°F. Thus the heat removed from the salt system in heating the air and the production of steam is external to the system. It is noteworthy that of the heat produced by combustion of catalyst deposit, 69 per cent is used to generate steam and 7 per cent for heat of reaction, giving an overall thermal efficiency of 76 per cent defined as useful heat recovered.

● **Yields.** Although this paper is not especially concerned with the yields of gasoline under various conditions, a typical weight balance is given in Table 3.

Commercial units produce 40-48 per cent of gasoline that has a clear octane number of 80 *CFR* Motor method. The cracked gas oil out is of suitable properties to be blended into domestic fuel oil.

● **Conclusion.** In the Houdry fixed bed cracking process, the principles of automatic control of a cyclic operation over a bed of pellet catalyst have been thoroughly worked out and proved in commercial practice. The design of the catalyst vessels includes provisions for heat transfer to permit efficient control of temperature for strongly exothermic or endothermic reactions, and when one portion of the process cycle is exothermic and another endothermic the range of physical variables that can be employed is very wide and can be made to suit any particular case. Pressures from 5 in. of mercury absolute to over 200 lb. per sq. in. gage have been used in this type of equipment, and the wide choice of operating cycle permits almost any degree of severity required. The temperatures at which this type of equipment can be used depend on the materials of construction, with present carbon steel converters catalyst temperature from about 650° to 875°F. are now being used.

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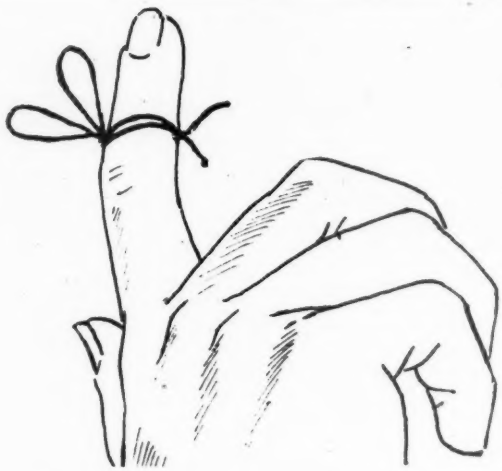
★ ★ ★



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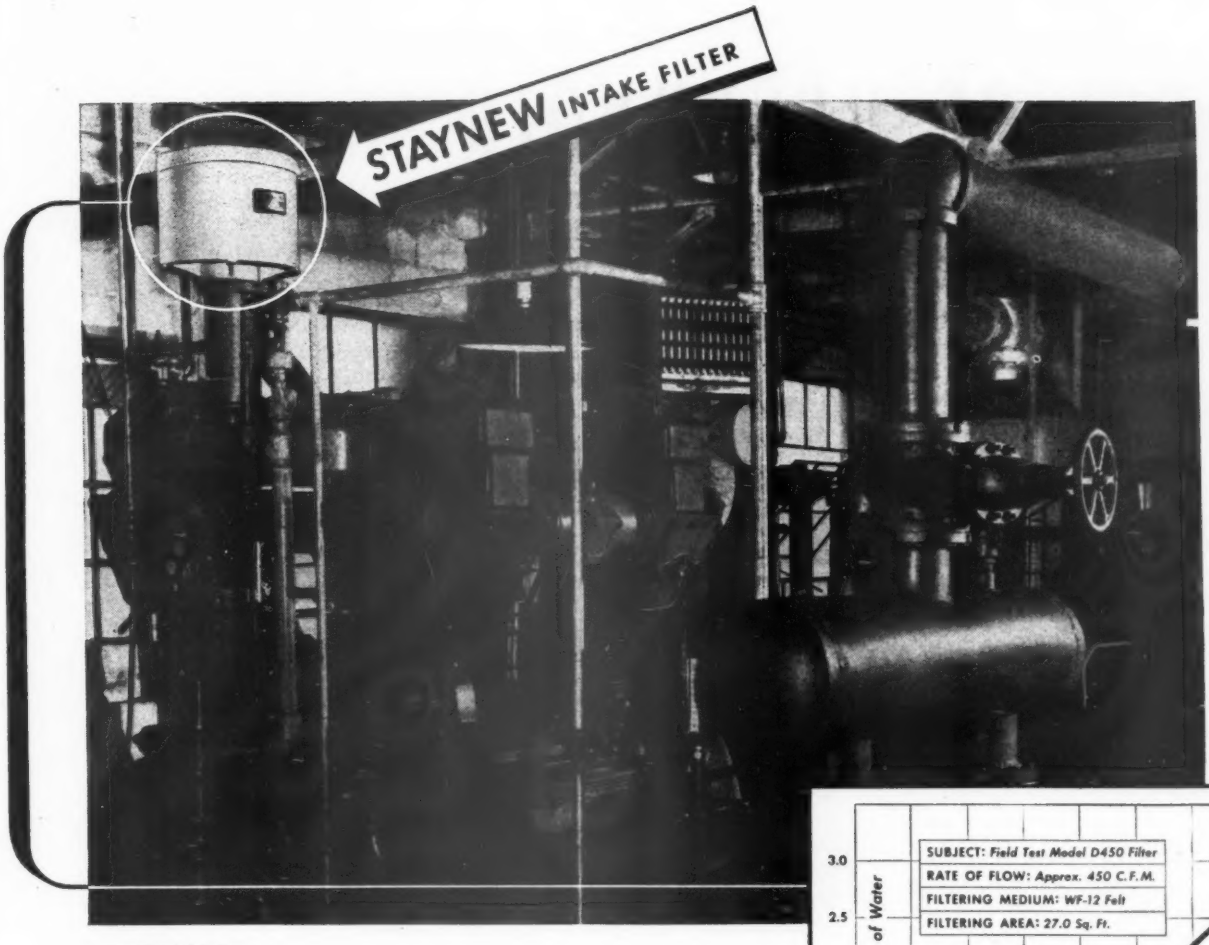

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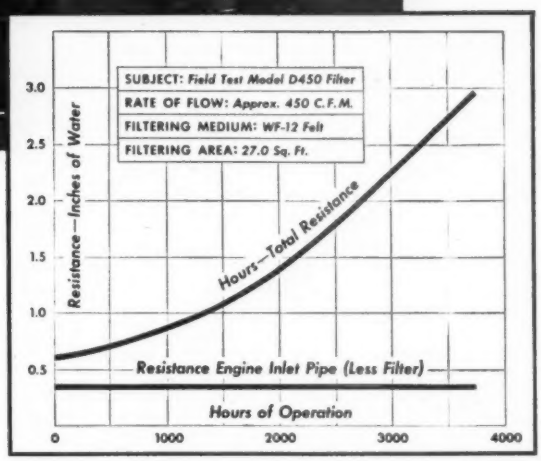

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EFFECT OF RESERVOIR DEPTH ON GAS RESERVES

By **K. MARSHALL FAGIN,** *Field Editor*

EXCLUSIVE

In view of the increasing number of high pressure gas fields being discovered at depths of 5000 to 12,000 ft., most production men are aware of the relatively greater importance of the gas reserves in these deeper fields compared with the shallower fields that have supplied the bulk of the natural gas supply in the past. The increased importance of the deeper gas fields is due simply to the fact that a larger quantity of gas is compressed in a unit volume of interstitial void space in the deeper reservoirs, because the pressure normally increases with depth. Table 1 illustrates the increasing importance of the comparatively new deep gas fields. More than 250 deep gas fields have been discovered in the past 15 years. Many of these are only partially developed at the present time due to a lack of market demand.

Table 2 shows the recoverable volume of gas from an acre-foot of similar sand at various depths. The sand selected for illustration in Table 2 would have 9801 cu. ft. of effective interstitial void space in an acre-foot at each depth shown in the left-hand column. A gas sand having 25 per cent porosity and 10 per cent connate water (a water-wet sand) would have an effective interstitial void space volume of 9801 cu. ft. per acre-foot. Likewise, a gas sand with 22.5 per cent porosity and no connate water would have the same void space.

For comparative purposes, the recoverable volume of gas from an acre-foot of such sand is defined as the number of cubic feet of gas as measured at the standard temperature and pressure conditions shown that would be produced from a closed reservoir having the initial pressure shown and a terminal (abandonment) pressure of 125 lb. per sq. in. gage at the wellhead. The standard temperature for measurement purposes is 60° F., and the standard pressure selected for use throughout this article is 0 lb. per sq. in. gage plus 4 oz., or 14.65 lb. per sq. in. absolute.

The recoverable volumes of gas have been corrected for deviation from Boyle's law in conformance with G. G. Brown's curves for natural gas having a specific gravity of 0.6 (compared with air with a specific gravity of 1.0).

Conditions Vary Locally

It should be emphasized that the initial reservoir temperatures and pressures shown in the table for the various depths are more important to the calculation of the recoverable volume of gas than the depths themselves. This is due to the wide variations in reservoir temperatures and pressures found in various localities and regions in fields of the same depth.

The temperatures and pressures used in the table for a given depth will be approximately right for many natural reservoirs at that depth, but many others may have considerably higher or lower temperatures and pressures.

K. M. Fagin

A pressure gradient of 0.435 lb. per ft. was used in setting up the initial reservoir pressures for the various depths shown in the table. The reservoir temperatures are computed on the basis of a 2000 ft. sand having a temperature of 120° F. and a temperature gradient of 15° F. per 1000 ft. below that depth.

Calculation of the recoverable volumes of gas from an acre-foot of similar sand under the conditions explained above indicate that about 5 times as much gas can be recovered from a depth of 15,000 ft. as from 2000 ft., and that only a little more can be recovered from deeper reservoirs. This is due to the adverse effect of increasing temperature and to the reversal of the effect of deviation from Boyle's law. Maximum benefit from the latter effect for natural gas of 0.6 gravity is reached by conditions shown at a depth of 4000 ft. on the table. From that depth to 10,000 ft. the benefit of deviation gradually vanishes, and from the conditions shown at 10,000 ft. the effect of deviation joins the increasing temperature in reducing the increase in the volume of recoverable gas that would be indicated by Boyle's law alone.

Importance of deeper, higher pressure gas fields is illustrated by charts and tables showing how recovery increases with depth.

The table may be used for rapid estimation of the gas reserves in lieu of making tedious detailed calculations. Estimates for fields that have not produced enough gas to cause significant declines in reservoir pressure may be made by interpolation of the figures in this table with practically as much accuracy as the thickness and extent of the fields can be estimated from well logs, structure maps, and core analyses.

For illustrative purposes, a gas producing reservoir is discovered at a depth of about 9000 ft., 4 wells are drilled and completed in the reservoir and indicate that the reservoir will have an average thickness of 50 ft. and cover an area of 4000 acres; the initial reservoir pressure is determined to be 4300 lb. per sq. in. gage (almost equal to the pressure shown for a 10,000 ft. field on the table) and the reservoir temperature is found to be 240° F.; the producing formation is oolitic limestone and a few core analyses indicate the average porosity is 15 per cent with no connate water indicated and the gravity of the gas is 0.6.

An estimate of the original reserve of this gas field may be made by use of the table as follows:

An acre-foot of formation 22.5 per cent porous has a recoverable gas volume of 2,110,000 cu. ft. according to the table for similar conditions of reservoir temperature and pressure, but the pressure in the given field is 50 lb. less than the pressure in the table, so the recoverable volume will be somewhat less, perhaps 2,100,000 cu. ft. The porosity of the formation in the given field is two-thirds as much as the effective porosity used in calculating the table, so the recoverable volume from each acre-foot in the given field will be about two-thirds as much, or 1,400,000 cu. ft. Then, the estimated original gas reserve for the field is 50 ft. (thickness) times 4000 acres (area), times 1,400,000 cu. ft., or 280,000,000,000 cu. ft.

Often the approximate thickness and porosity of a gas reservoir is known, but the extent of the reservoir is unknown. The estimated gas recovery per acre would then assume more importance, especially in a field that promises to be extensive, than an estimate of the reserve of the field as a whole, particularly with respect to determination of the spacing for the wells. Here, again, the table may provide a rapid method for estimating the ultimate gas recovery per acre and per well on the basis of various spacing patterns.

The gas recovery per acre may be estimated by multiplying the estimated effective thickness of the gas producing formation by the recoverable volume shown in the table for similar conditions of reservoir temperature and pressure. The product of this multiplication should be corrected for porosity by multiplying it by the estimated average porosity of the reservoir formation divided by 22.5, the net effective porosity used in calculating the table.

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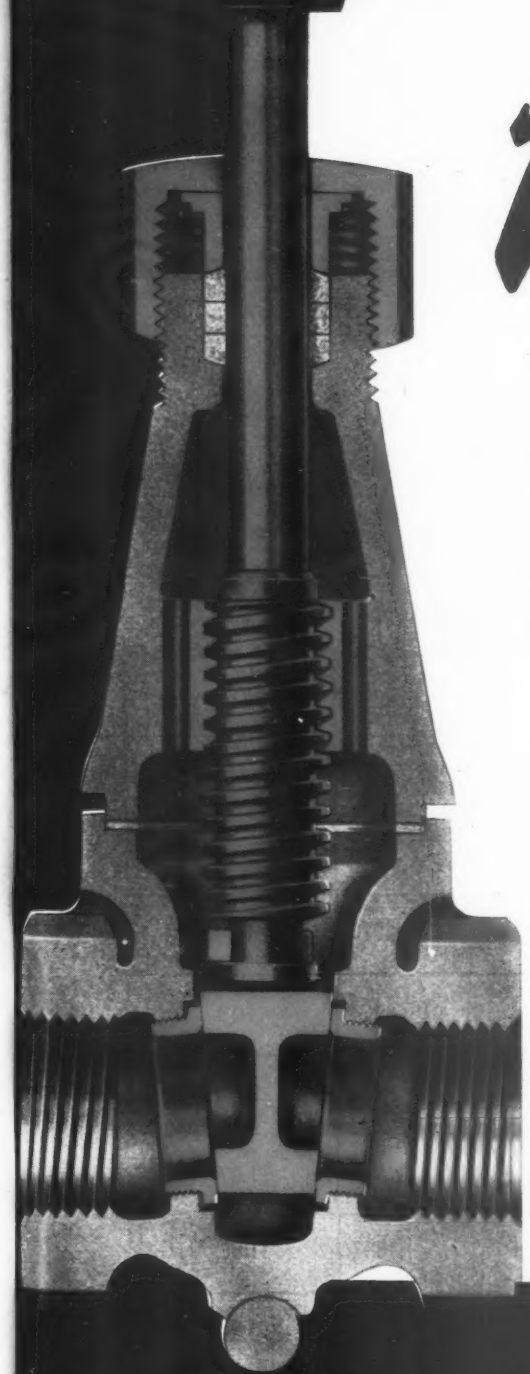

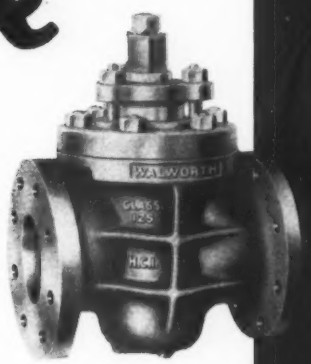

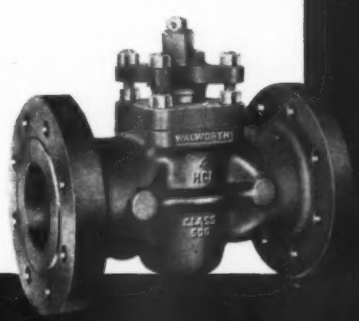

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example, is discovered in a new field. The reservoir temperature is about 180° F., and the initial reservoir pressure is 2600 lb. per sq. in. gage. The average porosity is estimated to be 25 per cent, and no connate water is believed to be present. The table shows about 1,500,000 cu. ft. recoverable volume for these conditions. Multiplying this by 25 (thickness in ft.) and by 25 divided by 22.5 (the porosity correction), the estimated per acre recovery from the newly discovered gas sand is 41,500,000 cu. ft. to a terminal pressure of 125 lb. per sq. in. gage at the wellhead. Then, wells spaced on 640-acre drilling units in this reservoir might be expected to produce ultimately 640 times this amount, or about 26,500,000,000 cu. ft. of gas, whereas wells spaced on 320-acre drilling units would each ultimately produce only one-half as much on the average.

Recoverable Volumes Versus Depth

The three columns on the right-hand side of Table 2 simply show the relative volume of the recoverable gas at the various depths compared (1) to the volume of the effective void space in the sand, (2) to the volume of gas that would be contained in an acre-foot of the sand at the terminal wellhead pressure of 125 lb. per sq. in. gage, and (3) to the volume of gas recoverable from an acre-foot of the sand that has the initial pressure and temperature conditions shown for a depth of 2000 ft.

Thus, it may be seen by inspection of these columns in the table for a reservoir whose depth is 10,000 ft., that the volume of gas recoverable from a unit volume of sand having the temperature and pressure shown is equivalent to (1) more than 215 times the actual volume of the effective porosity of the unit volume of sand, (2) slightly more than 22 times the volume of gas that would be contained in a unit volume of the sand at the terminal wellhead pressure of 125 lb. per sq. in. gage, and (3) 4.22 times the volume of gas recoverable from a unit volume of the sand having the tem-

TABLE 1

Depth and reserves of some of the large natural gas fields of the U.S.*

Field	Average depth, ft.	Estimated production, billions of cu. ft.	
		Cum., 1-1-45	Future
Fields less than 5000 ft. deep:			
Rio Vista	4,000	370	2,630
Hugoton	2,800	516	23,484
Monroe	2,200	3,700	1,300
Panhandle	2,500	10,900	19,000
Charleston	4,000	630	870
Fields more than 5000 ft. deep:			
Dorcheat-Macedonia	8,400	80	920
Logansport-Joaquin	5,000	105	1,095
Paradis	9,500	10	1,490
Erath	9,000	6	1,494
Cotton Valley	8,000	385	615
Old Ocean	10,500	440	5,810
Sheridan	10,000	3	1,997
La Gloria	6,000	25	1,775
Agua Dulce-Stratton	6,500	200	4,800
Carthage	6,000	50	4,950
Katy	7,000	100	9,900

*Additional information on these fields may be found in an article entitled "Review of Major U. S. Gas Producing Fields" in the September 1945 issue of *The Petroleum Engineer* on page 230.

FIG. 1. Small deep reservoirs yield as much gas as large shallow fields with similar sand.

CONDITIONS*			EQUIVALENT RESERVOIRS**				Ratio Between Acre-Feet of Sand in the Equivalent Reservoirs
Depth, Ft.	Press. PSIG	Temp. °F.	Uniform Area, One Acre	Sand Thickness, Ft.	Uniform Thickness, 100 Ft.	Sand Area acres	
2000	870	120		100.00		1.0000	5.46
4000	1740	150		47.17		.4717	2.58
6000	2610	180		33.11		.3311	1.81
8000	3480	210		26.88		.2688	1.47
10,000	4350	240		23.70		.2370	1.29
12,000	5220	270		21.74		.2174	1.19
14,000	6090	300		20.41		.2041	1.11
16,000	6960	330		19.53		.1953	1.07
18,000	7830	360		18.87		.1887	1.03
20,000	8700	390		18.32		.1832	1.00

*Per Table 2. Note: Pressure and temperature gradients vary with depth according to the locality, therefore all reservoirs having the same pore space characteristics and depth will not yield the same volumes of gas per acre-foot unless the reservoir pressure and temperature are the same.

**Each of these reservoirs will yield 50,000 M.C.F. of gas under the conditions given.

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perature and pressure conditions shown for a depth of 2000 ft.

Equivalent Reservoir Charted

Fig. 1 was constructed to scale to illustrate the importance of small gas reservoirs at depths greater than 2000 ft. A unit area of sand 23.7 ft. thick at a depth of 10,000 ft., for example, will yield about the same ultimate volume of natural gas as a unit area of similar sand 100 ft. thick at a depth of 2000 ft. Thus, a unit volume of sand at a depth of 10,000 ft. is about 4.2 times as important as a gas reserve as a unit volume of similar sand at a depth of 2000 ft.

Likewise, a unit thickness of sand at a depth of 10,000 ft. covering 0.237 acres will yield about the same ultimate volume of natural gas as a unit thickness of similar sand at a depth of 2000 ft. covering 1.000 acre. The importance of the 10,000 ft. deep sand compared with the 2000 ft. deep sand on a unit volume of sand basis is 4.2 as above.

Method of Estimating Reserves

For those who may wish to estimate the gas reserves in a particular field that does not have reservoir temperature and pressure conditions similar to those shown in the illustrations, the factors and formulas used in the calculations are as follows:

Factors:

1. Average porosity, per cent ÷ 100.
2. Connate water, 100 minus per cent ÷ 100.
3. Reservoir temperature, ° F.
4. Reservoir pressure, lb. per sq. in. gage.
5. Deviation factor, 1.00 ÷ z.

(z may be determined by laboratory analysis of a sample of the gas, or may be determined approximately from the specific gravity of the gas by utilization of two curves by G. G. Brown: (1) "Relation of psuedo critical temperature and pressure to gas gravity" published in *The Petroleum Engineer's* Continuous Tables in January, 1944, under the index number P 214.000, and (2) "Compressibility Chart for Natural Gas" published in *The Petroleum Engineer's* Continuous Tables in February, 1943, under the index number P 621.)

6. Terminal reservoir pressure, gravity of gas times depth of reservoir (ft.) times 0.0000361. Then, add 1.0 to this product and multiply by 125 lb. (the terminal wellhead pressure).

Formulas:

1. The effective interstitial *void* space per acre-foot = 43,560 times the porosity times the connate water factor.
2. The temperature correction (from the reservoir to the standard of 60° F.) = 460 + 60 ÷ 460 plus the reservoir temperature.
3. The pressure correction (from the reservoir to 14.65 lb. per sq. in. abs., or atmospheric pressure of 14.4 lb. per sq. in. abs. plus 4 oz.) = reservoir pressure (lb. per sq. in. gage) plus 14.65 ÷ 14.65.
4. The terminal pressure correction, or the recovery factor = reservoir pressure (lb. per sq. in. gage) minus the terminal reservoir pressure divided by the reservoir pressure plus 14.65.

The above formulas may then be put together as follows in the main formula:

The *void* times the temperature correction times the pressure correction times the deviation factor = cu. ft. of gas in place in an acre-foot of the sand. This times the terminal pressure correction = cu. ft. of gas recoverable from the acre-foot of sand (assuming no underground drainage from other acre-feet and no water or oil encroachment that would tend to increase the recoverable volume slightly).

TABLE 2

Volume of gas recoverable from one acre-ft. of gas sand having 9801 cu. ft. of void space* at various depths, temperatures, and pressures—corrected for deviation†				Ratio of recoverable volume of gas to effective void space in the sand	Ratio of recoverable volume of gas to volume contained in sand at terminal pressure	Ratio of recoverable volume of gas to recoverable volume in sand at depth of 2000 ft.
Depth, ft.	Temp., °F.	Press., PSIG	Volume, std.‡ cu. ft.			
0	60	0+4 oz.	9,801△	1.000	.102	.020
287✦	60	125	95,758△	9.770	1.000	.192
2,000	120	870	500,000	51.015	5.221	1.000
4,000	150	1740	1,050,000	107.132	10.965	2.120
6,000	180	2610	1,510,000	154.066	15.769	3.020
8,000	210	3480	1,860,000	189.777	19.424	3.720
10,000	240	4350	2,110,000	215.284	22.035	4.220
12,000	270	5220	2,300,000	234.670	24.019	4.600
14,000	300	6090	2,450,000	249.974	25.585	4.900
16,000	330	6960	2,560,000	261.198	26.734	5.120
18,000	360	7830	2,650,000	270.381	27.673	5.300
20,000	390	8700	2,730,000	278.543	28.509	5.460

*A gas sand having 22.5 per cent porosity and containing no connate water would meet this specification.
†Using G. G. Brown's curves for 0.6 gravity natural gas.
‡Corrected to
14.65 lb. per sq. in. abs. (=0.0 PSIG+4 oz.).
and 60°F., and using a terminal pressure of 125 PSIG at the wellhead.
△These are simply the volumes contained in an acre-ft. of the given sand. The figures below represent recoverable volumes.
✦Equivalent to terminal wellhead pressure.

Example of Calculations

As an illustration of the method of using the formula, the following determinations were made in calculating the recoverable volume of gas from an acre-foot of sand at 4000 ft. for use in Table 2:

43,560 × 0.25 (porosity) × 0.90 (connate) = 9801 cu. ft. of interstitial void . . . . . (1)

$$\frac{460 + 60 \text{ (standard surface temp.)}}{460 + 150 \text{ (reservoir temp.)}} = 0.8525 \text{ (the temperature correction)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\frac{1740 \text{ (reservoir press.)} + 14.65}{14.65 \text{ (abs. atmos. press.} + 4 \text{ oz.)}} = 119.771 \text{ (the pressure correction)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\frac{1740 + 14.65}{672 \text{ (pseudo critical press.)}} = 2.6 \text{ (reduced press.)}$$

$$\frac{460 + 150}{360 \text{ (pseudo critical temp.)}} = 1.69 \text{ (reduced temp.)}$$

Then, from the compressibility curve z = 0.87 and 1.00 ÷ z = 1.15 (dev. fact.) . . . . . (4)

(void) (temp. corr.) (press. corr.) (dev.)

9801 × 0.8525 × 119.771 × 1.15 = 1,150,838 cu. ft. of gas in place in an acre-foot of this sand . . . . . (5)

$$\frac{1740 - 136 \text{ (res. term. press.)}}{1740 \text{ (res. press.)} + 14.65} = 0.914 \text{ (the terminal press. corr., or recovery factor)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

And finally: 1,150,838 cu. ft. (gas in place) × 0.914 (recovery fact.) = 1,051,866 cu. ft. of recoverable gas from an acre-foot of sand having the conditions given. This answer has been arbitrarily rounded out in Table 2 to the estimate of 1,050,000 cu. ft. Similar calculations may be applied to actual conditions found in any gas field. ★ ★ ★

Want leasing policy amended

New oil reserves discovered in the Rocky Mountains, particularly in Wyoming and Colorado, has resulted in demands by the oil industry for modification of the national leasing policy. Since 1920 oil and other nonmetallic minerals on the public domain have been subject only to lease.

In 1942 the O'Mahoney Act was passed that provided a flat royalty of 12.5 per cent for the government on any discoveries on the public domain made during the emergency. Previous to that the standard royalty had been 12.5 per cent to 32 per cent, depending on volume of oil, the maximum being reduced to 25 per cent early in 1945. The industry says that the flat rate, together with the demand for oil during the war, are factors that played a big part in Rocky Mountain development. They charge, however, that uncertainty and slowness of rulings by the Interior Department still handicap discovery and development on a large scale.

Hearings have just been held throughout the Rockies by a Senate Public Lands Committee subcommittee on a new bill by Senators O'Mahoney and Hatch that would simplify administration, provide a minimum advance royalty of $1 an acre a year, raise the acreage limits that could be leased to any one operator in any one field or state, and provide that new discovery in an old field would give the whole field the status of a new discovery.

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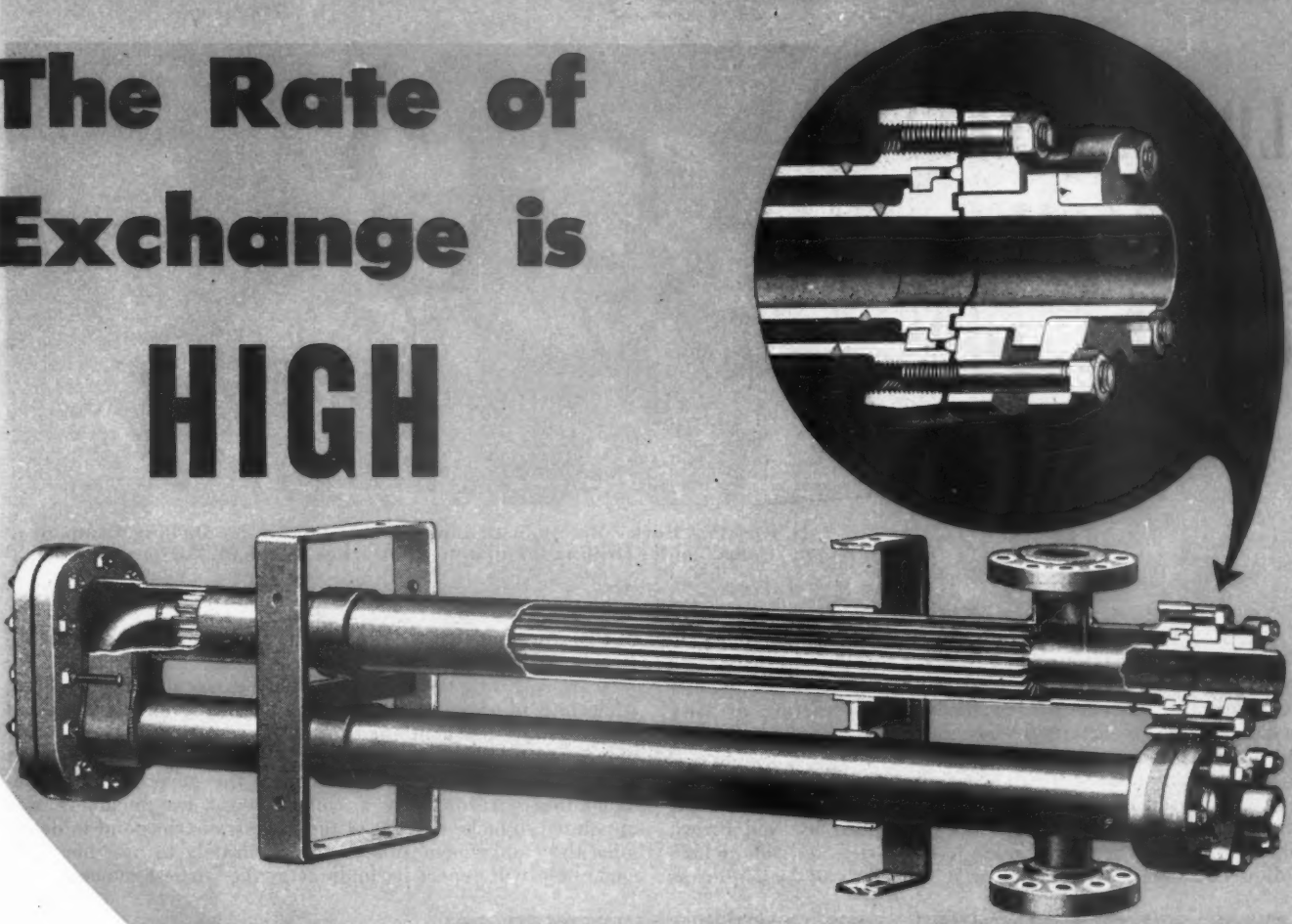

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LOS ANGELES DRILLING CONTRACTORS MEET

A, D. Rushing, Rocky Mountain Drilling; Carl Gates, Fowler Drilling Company; C. L. Fowler, Fowler Drilling Company; Neil Durkee, Ralph M. Parsons Company.

The Los Angeles chapter of the American Association of Oil Well Drilling Contractors were called together by Chairman Ned Brown at the University Club on the evening of September 6, to discuss government recommendations relating to work schedules, and to determine how best to conform to the suggestions as outlined.

The meeting opened with a dinner that appeared to be thoroughly enjoyed by some 45 drilling contractors. After dinner, the purpose of the gathering was expounded by Ned Brown and the matter was thrown open to discussion. A lively debate followed. Summing up all angles, it seemed to be the consensus of those present that the crux of the situation was the availability of qualified help.

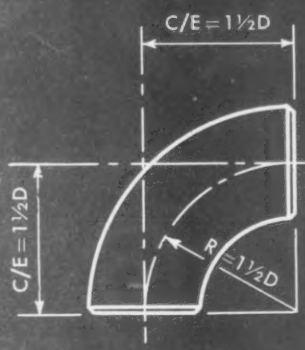
Scarcity during the war years, and the urgency of the drilling program had necessitated the adoption of a seven-day week and that schedule has continued to the present time. The shortage of adequate help still exists but it was felt nonetheless that every effort should be made to meet the government recommendations. Accordingly a committee of five members was appointed to make surveys of the various districts and to determine the employment situation as accurately as possible. This committee will report its findings at the earliest moment.

★ ★ ★

Left—J. E. Pettijohn, driller; F. N. Kellogg and Karl Kellogg, Kellogg Drilling Company; Walt Parker, General Drilling Company. *Below, left*—Walter F. Buaas, Buaas Drilling Company; Ralph Marshall, Drilling and Exploration Company. *Below, right*—Standing, Paul Shephard, Ralph M. Parsons Company; Stan Williams, Pike Drilling Company. Seated, R. C. Bundy, Camay Drilling; Tom Pike, Pike Drilling; J. F. Cooper, T & T Drilling Company; Walter Thompson, T & T company.

ONLY MIDWEST OFFERS A COMPLETE SELECTION OF 90° WELDING ELBOWS

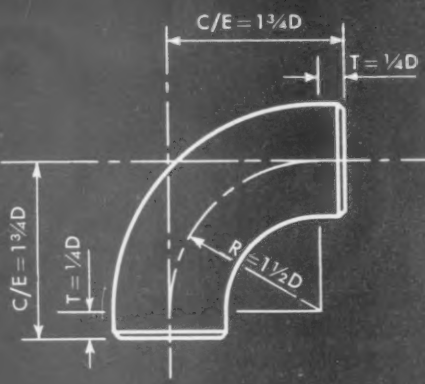
1 LONG RADIUS AMERICAN STANDARD



SIZES: 3/4" TO 12", INCLUSIVE

All dimensions conform to the American Standard for Steel Butt-Welding Fittings ASA B16.9. Unless order specifies otherwise, these "ASA Elbows" will be furnished.

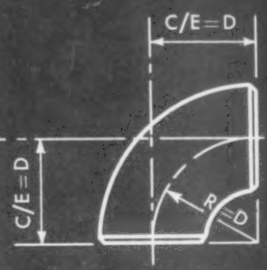
2 LONG RADIUS LONG TANGENT



SIZES: 2" TO 20", INCLUSIVE

Same radius as "ASA Elbows" but with long integral tangent on each end—an exclusive Midwest feature that saves time and pipe, and sometimes eliminates an extra weld.

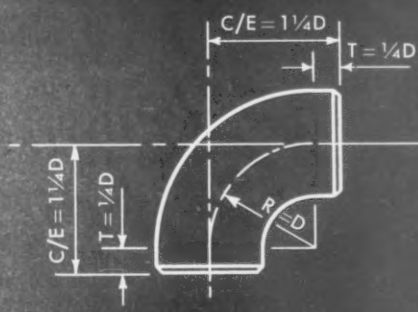
3 SHORT RADIUS



SIZES: 1" TO 12", INCLUSIVE

Where space limitations prevent the use of "ASA Elbows" or Midwest "Long Tangent" Elbows shown at left, these short turn elbows without tangents are recommended.

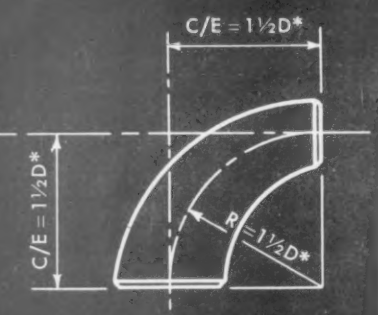
4 SHORT RADIUS LONG TANGENT



SIZES: 14" TO 24", INCLUSIVE

These OD sizes are short radius but have the exclusive Midwest long tangents that save pipe and make it possible to line up the fitting and pipe more quickly and accurately.

5 LONG RADIUS REDUCING



SIZES: 2" TO 12"*, INCLUSIVE

Only Midwest makes the reducing welding elbow which takes the place of a straight elbow and a reducer. It eliminates one weld, cuts installation cost, and reduces pressure drop.

SYMBOLS:

C/E = Center-to-End Dimension
D = Normal Pipe Size
R = Radius
T = Length of Tangent
*D = Dimension is Larger Pipe Size

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DESIGN OF THE GOLETA DEHYDRATION PLANT*

By **RICHARD H. HULL**
Pacific Lighting Corporation

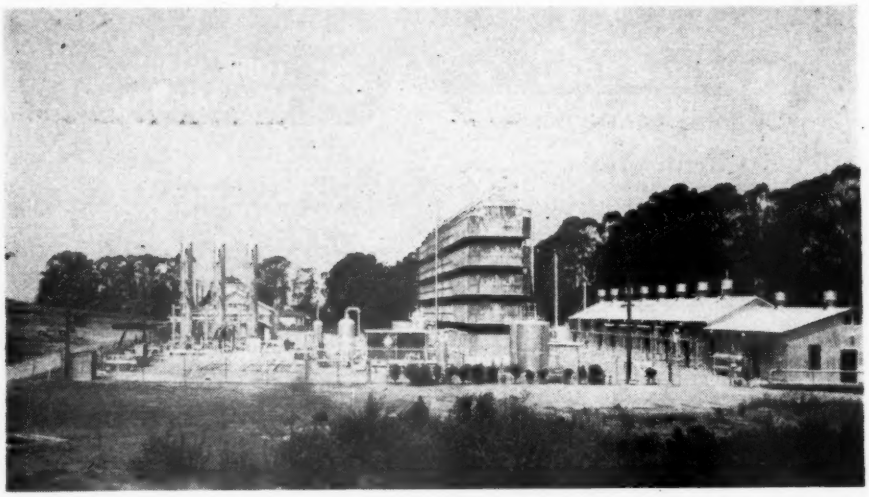
THE Goleta dehydration plant is at Pacific Lighting Corporation's compressor plant site in the Goleta gas field, about 10 miles west of Santa Barbara, California. Its purpose is the dehydration of the gas that is withdrawn from storage in the field and delivered into the Southern Counties Gas Company's 16-in. line at 1000 lb. per sq. in. gage for eventual delivery into the Los Angeles Basin Area.

Richard H. Hull

During the winter, which is the normal withdrawal period, the ground temperatures along the line drop to about 54°F. To prevent water from condensing in the pipe line and also to prevent the probable formation of hydrates, it is necessary to lower the dewpoint of the gas to a point below the ground temperature. The dehydration plant is designed to handle 150 million cu. ft. of gas per 24 hr. and to depress the dewpoint approximately 40°F. below the incoming temperature. This incoming temperature is maintained from 78°F. maximum to 70° minimum.

If the temperature were allowed to drop below 70°F. there is the possibility of hydrate formation in the saturated gas ahead of the dehydration plant and consequent freezing of the piping. The gas is processed and delivered into the line near this temperature and the 40° depression gives a resultant dewpoint of about 38°F. maximum, safely below the ground temperature.

The dehydration plant equipment and piping are designed to operate up to 1050 lb. per sq. in. gage in order that the gas may be processed and metered into the line at 1000 lb. per sq. in. gage. The gas enters the dehydration plant and is reduced from field pressure to a pressure of about 1025 lb. per sq. in. gage by means of two regulators operating in parallel. The control pressure on the master regulators is taken from the meters downstream from the dehydration plant. This automatically compensates for plant pressure losses so that it is not necessary to juggle the regulated pressure to try to meet the desired delivery pressure. The regulators operate so that a low volume will be handled by one regulator only, with the second regulator opening automatically and the two equalizing when the first has reached near its capacity. An additional controller is set as a safety to prevent the regulators from building the pressure above 1050 lb. per sq. in. gage into the plant.



General view of 1000-lb. dehydration plant.

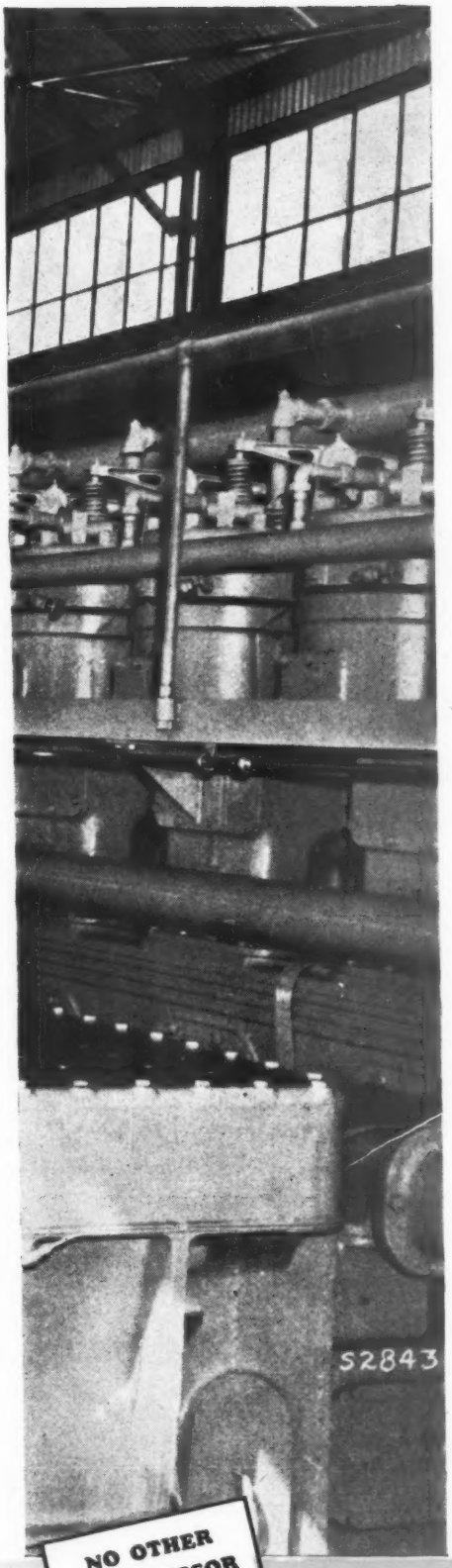
After the pressure is reduced, the gas passes through cooling coils where it is cooled from field temperature to approximately 78°F. and then through mechanical separators, which remove the free condensate. From the separators the gas flows through diethylene glycol contactor towers where it is intimately contacted with the diethylene glycol (called DEG for convenience) which absorbs the water vapor and a portion of the gasoline vapors. From the contactors the dry gas passes through regulators and is metered into the pipe line.

There are three contactor towers operating in parallel. These towers were designed each to handle 50 million cu. ft. of gas per 24 hr. at 1000 lb. per sq. in. gage plus a 20 per cent overload factor. The overload factor serves to take care of emergency demand or, during normal operation, further to depress the dewpoint. The contactors are 50 in. in diameter with a net shell length of 33 ft. 7 in. and are built for a working pressure of 1070 lb. per sq. in. gage. The gas enters at the bottom of the tower, passes through a baffle-nest, which serves to remove any remaining free condensate, rises through a series of four bubble-trays where it is contacted with the DEG, and flows out at the top of the tower through a mist extractor tray and a final baffle-nest, which removes any DEG that might otherwise carry over with the gas in mist form.

In the outlet line from each contactor there is a motor valve that serves a dual purpose. The primary purpose is to equalize the gas flow through the contactors. This is accomplished by controlling the motor valves with flow equalizer instruments, which in turn are activated by the differential across orifice plates set in the discharge lines from each contactor. The gas lines to and from the contactors are manifolded so that on low volume, 50 million cu. ft. per 24 hr. or less, any one of the contactors can be placed in service. As the volume is increased the second and third contactors can be placed in operation as necessary to handle the load. At any time 2 or 3 contactors are in service the flow equalizers operate to divide the load equally between them. The second purpose is to maintain a minimum back pressure of approximately 950 lb. per sq. in. gage on contactors. In case the gas pressure in the line is pulled down unexpectedly the resultant increase in volume and velocity through the contactors would probably carry over the DEG with the gas stream and might even be great enough to damage the bubble-trays due to the high differential across them. By holding a high minimum downstream pressure, back pressure controllers prevent any large pressure drop through the vessels.

The DEG, combined with water and gasoline, from each contactor flows out into a float tank 16 in. in diameter by 13 ft. in which the proper level is main-

*Presented before California Natural Gasoline Association, Downey, August 1945.



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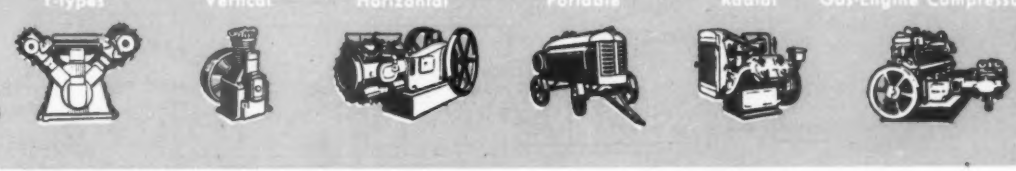
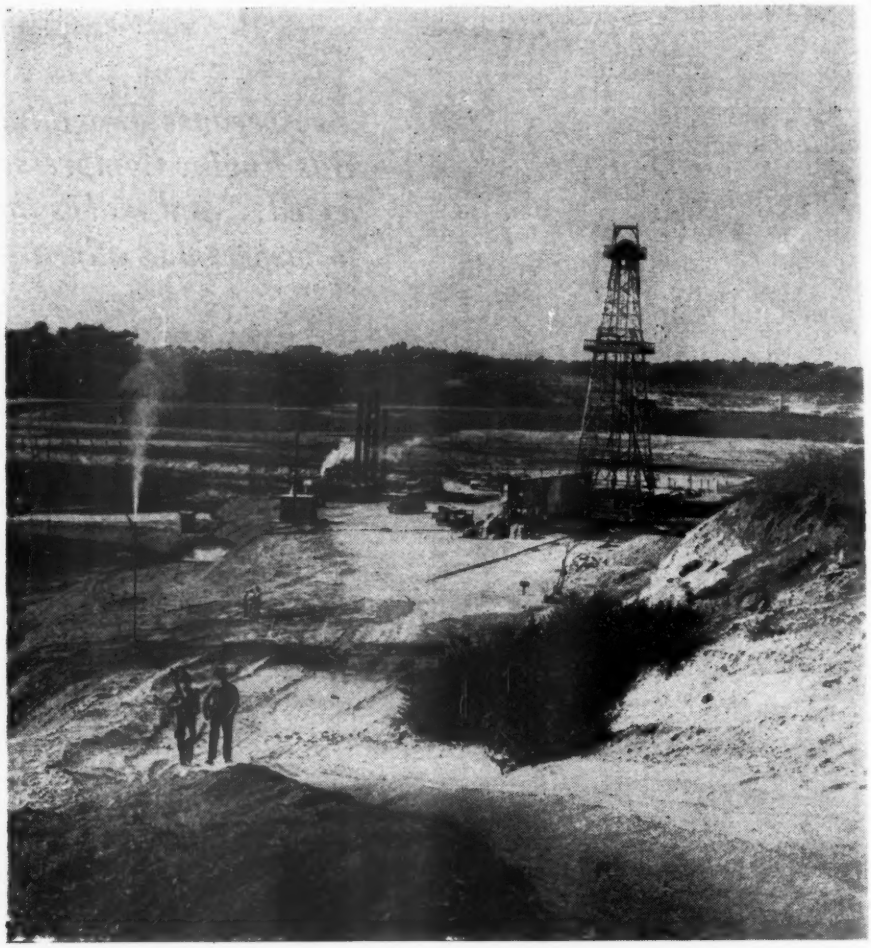


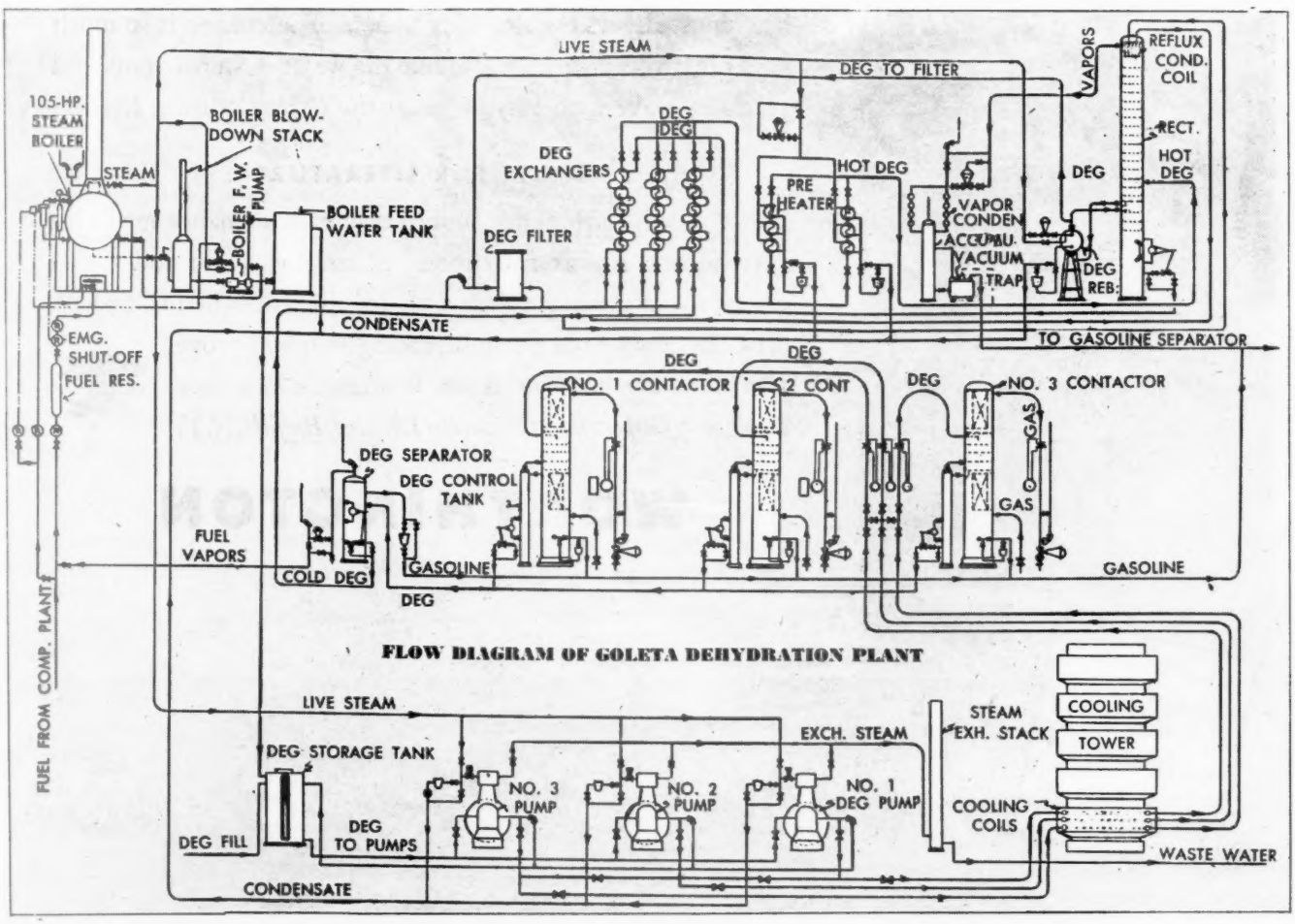
Production test in Miller No. 1.



tained by means of a liquid level controller. From the individual float tanks the liquid streams are combined and pass into a gasoline separator tank. Here most of the gasoline separates from the DEG and is drained off through a trap to gasoline storage tanks.

A certain amount of wet gas entrained in the DEG from the contactors is also released in the separator. This gas combined with gasoline vapors is released at the top of the vessel through a back pressure regulator and is piped into the boiler fuel system. The DEG and water mixture are drawn from the bottom of the separator through a motor valve controlled by a liquid level controller, which has its float set at the interface between the DEG surface and the gasoline in the tank.

The mixture is then piped into a series of heat exchangers consisting of three parallel banks, each containing five G-Fin exchangers. From the line between the separator and the heat exchangers a portion of the cold DEG is by-passed through a coil in the top of the rectifier and then is returned to combine with the main stream into the exchangers. The cold coil in the top of the rectifier condenses rising vapor which serves as a reflux. In exchange the DEG passing through the coil absorbs an equal amount of heat. In the exchangers the DEG receives its first stage of heating from counter-flowing hot DEG return-



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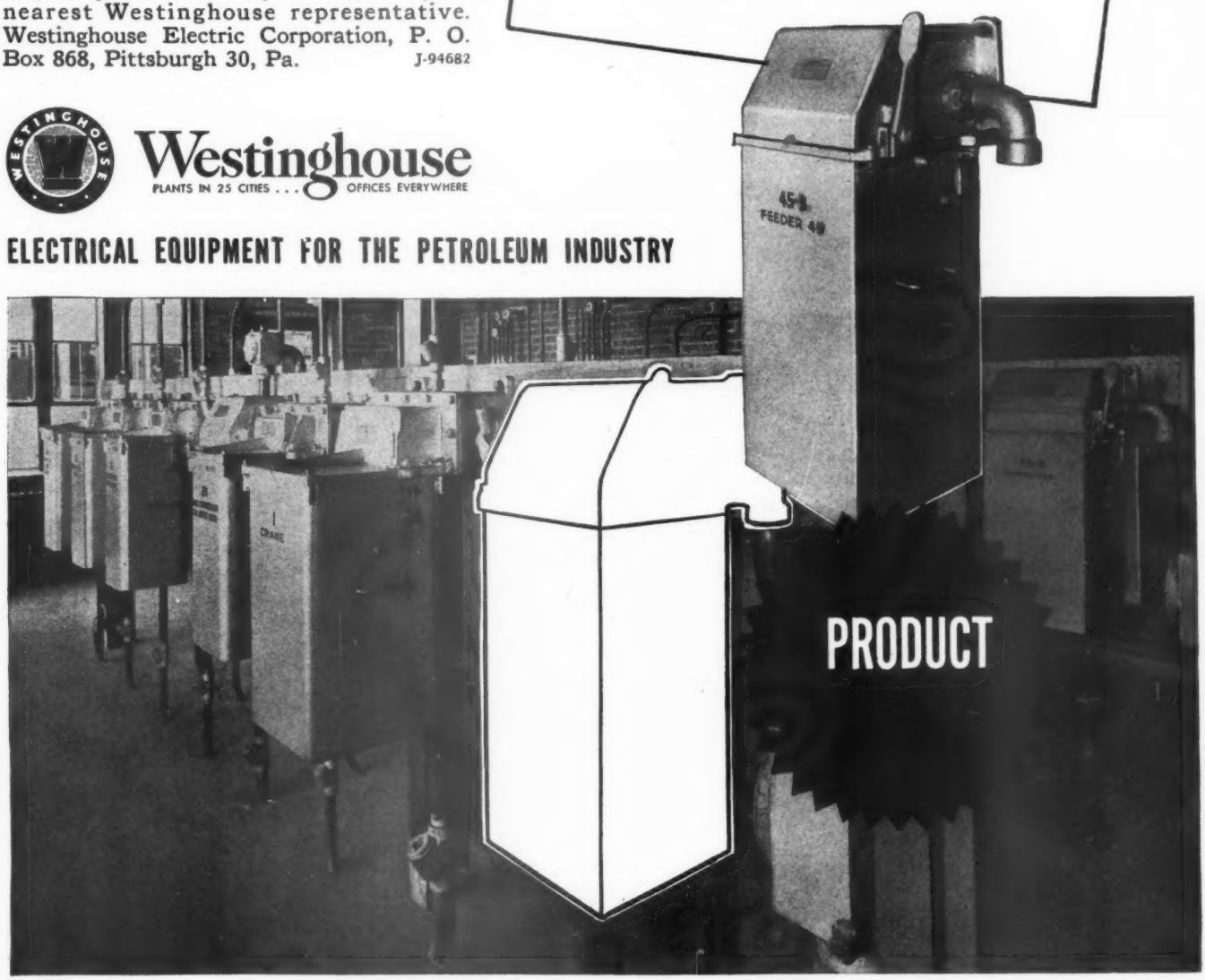
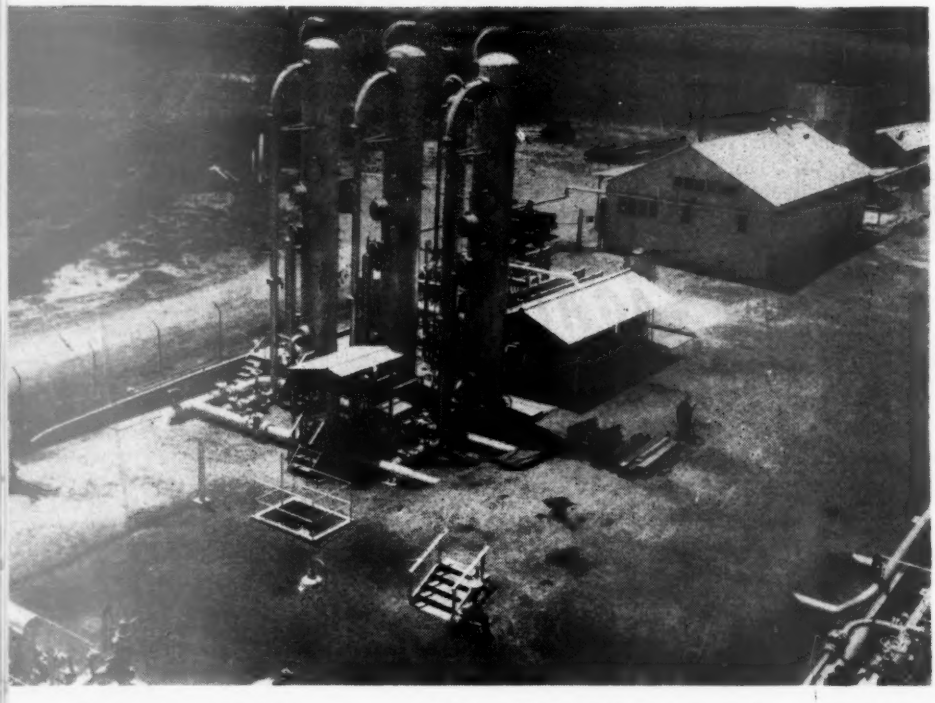




Contactor gas piping.

ing from the rectifier to storage. The warmed DEG then passes through a set of preheaters, consisting of two parallel banks, each containing three G-Fin exchangers, where it is heated by steam to a temperature sufficient to evaporate the entrained water and any remaining small amount of gasoline.

The outgoing temperature of the DEG is controlled by a temperature operated motor valve set in the steam line to the pre-heaters with a control bulb in the DEG line. This motor valve can be set to maintain any desired temperature in the DEG and it achieves this result by increasing or decreasing the quantity of steam admitted to the pre-heaters.

From the pre-heaters the flashing mixture of DEG and water vapor is piped into the rectifier, or still. This is a column 26 in. in diameter by 29 ft. 10 in. net shell length, built for working pressure of 50 lb. per sq. in. gage, which contains 14 bubble-trays and 6 trays of other types. Most of the water vapor is separated from the DEG in the bubble-trays when it first enters the column. The lean DEG is then drawn off and passed through a reheater, which is a horizontal 13 in. by 10 ft. shell-and-tube type of heat exchanger, where its temperature is again raised by steam to a point where any remaining water is vaporized. The temperature of the DEG from the reheater is fixed by a temperature control regulator set in the steam line to the reheater with the control bulb in the outgoing DEG line. From the reheater the DEG is returned to the lower part of the rectifier to allow this final vapor to escape.

The water vapors, which are driven off in the rectifier, rise through the column and when they contact the cold condenser coil in the top, a portion of them are condensed as a reflux. The balance of the vapors are released through a back pressure regulator, which maintains the desired operating pressure on the vessel. These vapors are then condensed in a set of air-cooled fin tube exchangers and the liquid collected in an accumulator. Here the quantity of liquid can be checked and it can be tested for any content of DEG, gasoline, etc., which might carry over with the vapors, thus showing whether or not the rectifier is properly operating. The hot lean DEG is released from the bottom of the rectifier through a motor valve operated by a liquid level controller, flows through the DEG heat exchangers where it imparts heat to the incoming cold DEG-water mixture, and then is piped to a storage tank.

In order to remove any dirt, carbon, etc., which may accumulate in the DEG, the line between the reheater and the rectifier is tapped and a small stream of DEG is drawn off and passed through a filter. This filtered DEG is then piped directly to the storage tank.

The DEG is drawn from the storage tank by three steam engine driven 1½-in. by 2-in. vertical triplex pumps, operating in parallel. It is pumped through three parallel banks of atmospheric cooling sections where it is cooled to approximately the temperature of the gas being treated, and then enters the contactors through indicating flow meters.

There are two manifolds in the DEG piping, one at the pump discharge and one in front of the contactors, which make the DEG system completely flexible. Normally each pump puts liquid directly through one bank of coils and into one contactor with the volume being determined by the speed of the pump. In case any pump, bank of coils, or contactor must be out of service, however, the manifold system allows any of the pumps to put DEG through any of the coils into any of the contactors. In case the DEG streams have to be combined, as in the case of two pumps serving three contactors, the liquid is separated in the manifold at the contactors and the flow equalized into the vessels by means of the indicating flow meters. As the volume of liquid handled by any of the pumps can be varied as much as 50 per cent above or below normal flow by changing the pump speed, it is unnecessary to have additional stand-by pumps to take care of emergency shutdowns for repairs, etc., as it would be quite unlikely that more than one pump would be out of service at any one time.

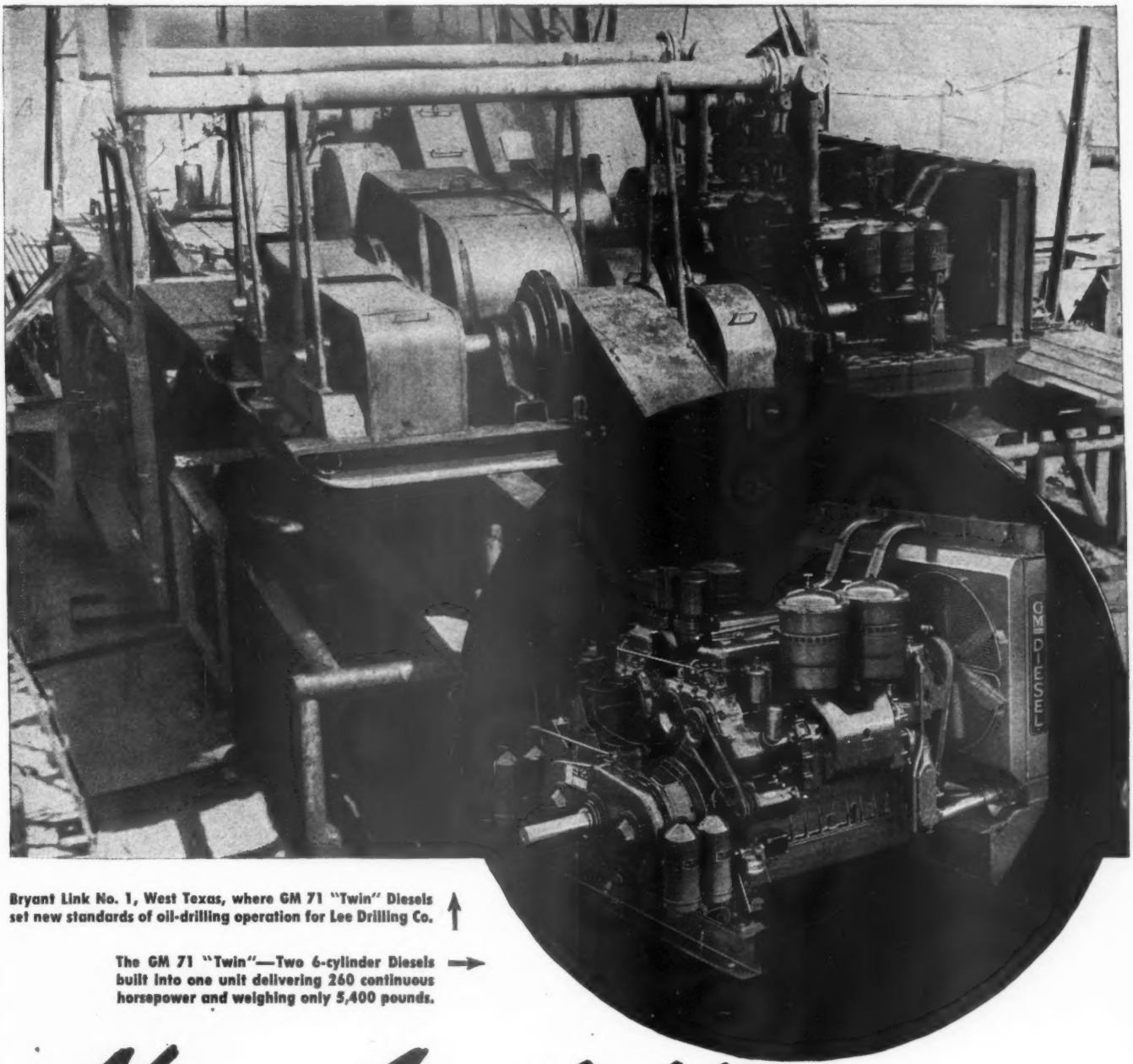
Steam for heating and for operating the pumps, engines, etc., is generated in a 1050-sq. ft. HRT boiler, operating at 150 lb. per sq. in. gage and giving a resultant steam temperature of approximately 366°F. The boiler fuel is automatically controlled from the boiler pressure by means of a pilot operated motor valve set in the fuel line. An additional motor valve set in the fuel line serves as a safety valve and automatically cuts off the fuel in case of too high or too low water level in the boiler. The pilot of the safety shut-off valve is activated by steam pressure from a float valve in the boiler water column. At the same time the safety shut-off is closed a whistle is blown to warn the operator.

The boiler feed water pump is a steam driven horizontal duplex pump. The speed of the pump is controlled by a pilot operated motor valve in the steam feed line, activated by a liquid level controller on the boiler. All condensate from the main steam line, headers, preheaters, and reheater is returned to the boiler feed water tank. The only waste steam is that exhausted from the engines driving the DEG pumps. This steam is wasted because of the fact that it might contain some slight oil content from the engines, and the quantity is so small that it was not considered worthwhile to install equipment to guarantee positive separation.

All condensate removed from the gas by traps or separators or by contact with the DEG is piped to a gasoline water separator. Here the water is drawn off through a motor valve operated by an interface liquid level controller, and is piped into a waste water system. The gasoline is trapped off and put into storage.

All pressure vessels in the plant are designed and built in accordance with the API-ASME code for unfired pressure vessels. All piping is designed in accordance with ASA Code for Pressure Piping, listed as ASA B31.1-1942, the gas piping being designed under Division 1 "Gas and Air Piping Systems."

All controls, automatic devices, safety equipment, etc., are either pressure or temperature operated. This makes the plant completely independent of any electrical service, except for lighting purposes. This is advantageous in that the demand for the plant is in the wintertime when due to storms, etc., there is more likelihood of electrical failures in the rural systems. ★★★



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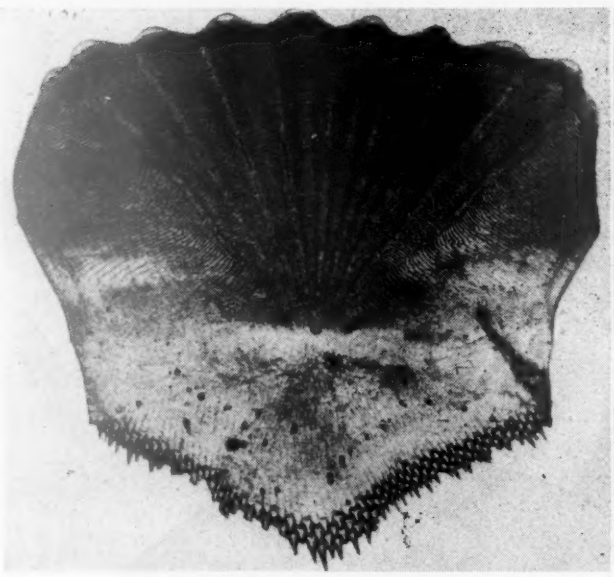
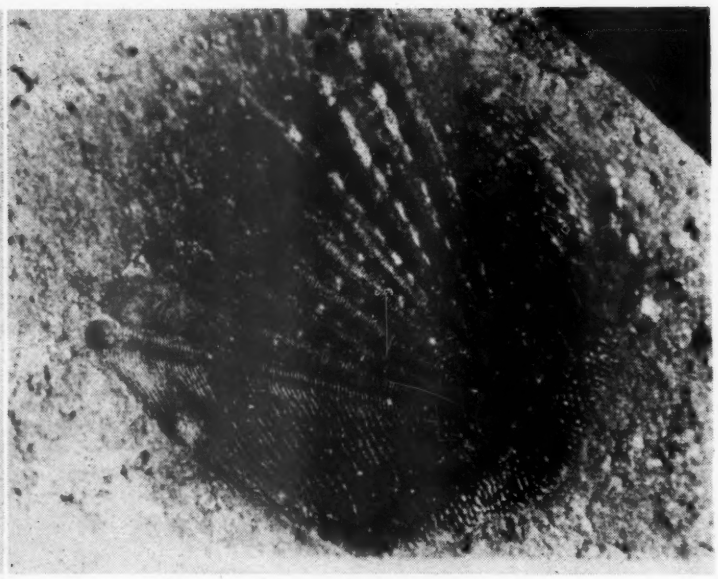


Scale of the porgy fish today.



Fossil scale of a porgy fish.

NEW SCIENCE IDENTIFIES SUB-SURFACE STRATA FROM FOSSIL FISH SCALES

By **RICHARD SNEDDON,** *Pacific Coast Editor*

EXCLUSIVE

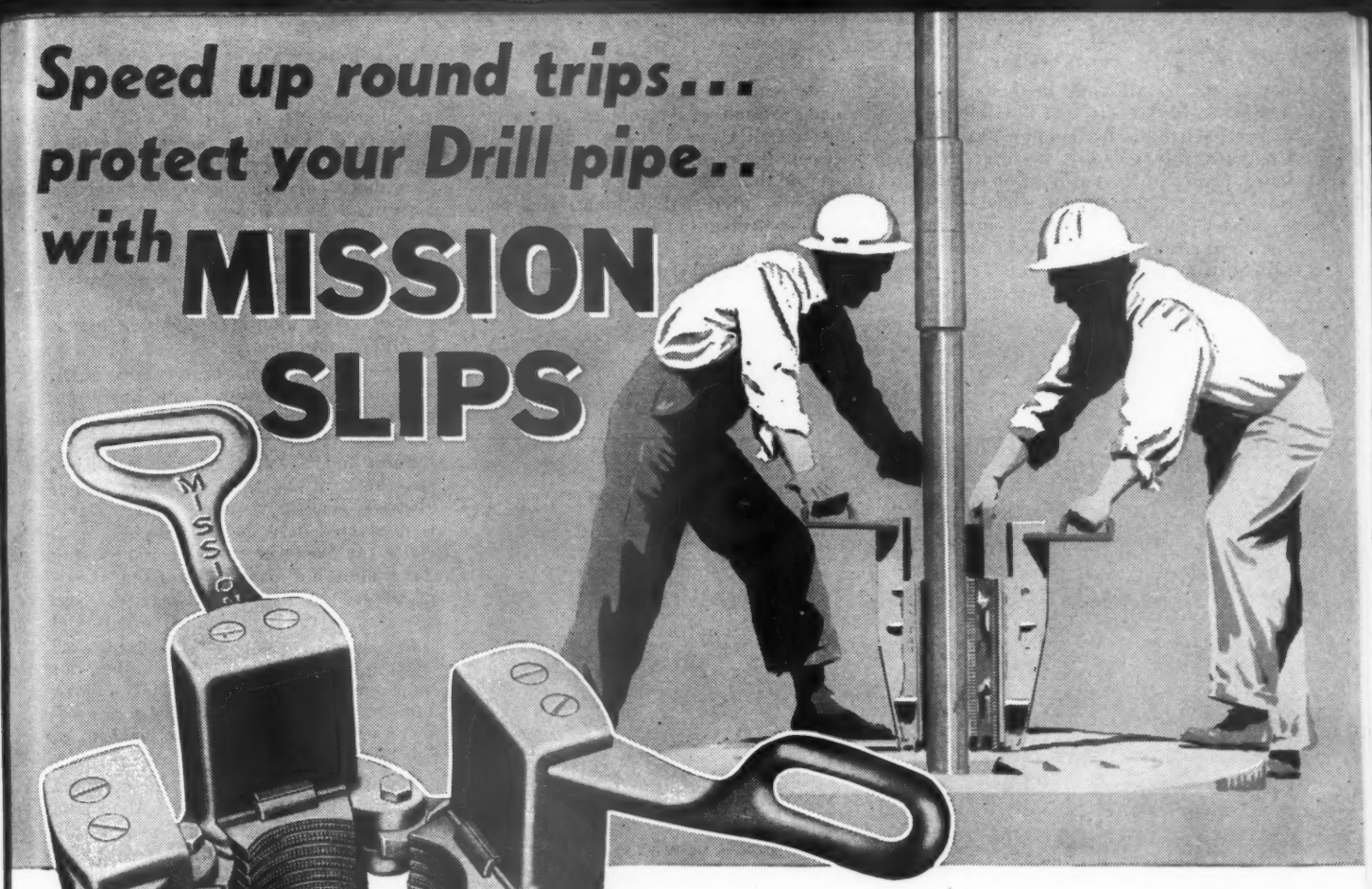
In every phase of the complex and diverse operations that constitute the petroleum industry, engineers and technologists of infinite variety have pursued an unremitting search for improved machines, more efficient processes, and better products or services. Nothing is allowed to remain static. Down through the years this constant seeking for the better way has succeeded in building a gigantic institution of incalculable worth and of such incomparable utility that it virtually affects every facet of social and industrial existence.

An examination of oil finding methods and their evolutionary development from the old divining rod, through generations of witches and doodle bugs, to the highly modern polysyllabic practices of the present day, yields an interesting sample of the progress that stems from this relentless probing by inquisitive scientists. From an extremely haphazard adventure the business of oil finding has blossomed into a combination of processes that although not yet by any means infallible, at least have their bases in scientific principle, and hence are vastly more positive than most of the weird rituals that preceded them.

Geology seeks to correlate subsurface strata on the basis of ages and constitution. Micropaleontology determines the relationship of structure by the numbers and types of tiny marine organisms that each contains, as indicated by fossil content. Geophysics utilizes an artificial earthquake, and then identifies the strata by their effects on the sound waves produced, so-called seismic exploration. These three sciences have become the universally accepted exploration media. Each has a distinctive approach to the same problem. Each has to its credit the accumulation of information that has added liberally to the sum total of pertinent data. The correlation of the results

Chipping fossils out of the cores is a delicate job that has to be done with great care to preserve all identifying characteristics.

Speed up round trips... protect your Drill pipe.. with MISSION SLIPS



***The* MISSION ROLLING DOG** principle employs a series of pipe engaging dogs stacked in each segment. When the pipe is engaged, each dog rolls down slightly, grips the pipe firmly—saves the time lost in trying to make ordinary slips hold. When the pipe is lifted, the dogs roll upward, instantly releasing the hold on the pipe, and freeing the slips from the bowl.

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Light weight, perfect balance and well designed handles make Mission Slips easy and quick to handle.

All these points of superiority, proved by years of successful field service all over the world, add up to one fact. For faster, safer handling of pipe—use Mission ROLLING DOG Slips.

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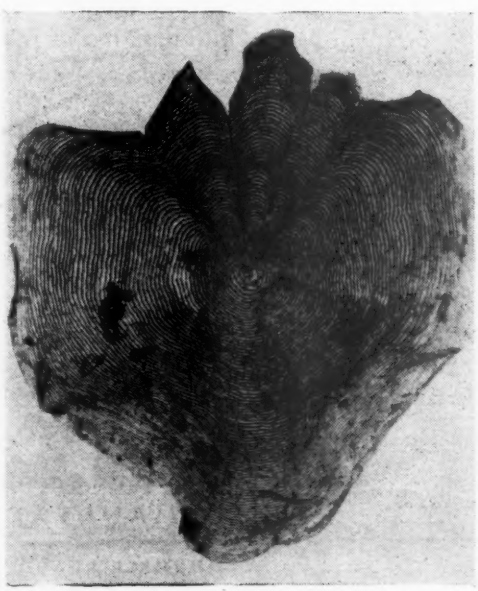
of surveys by all three methods simultaneously, in the very best possible gage of prospective production now available. Comparatively recently, however, there have sprung up in the field of exploration some exciting new shoots—geo-chemistry, geo-biology, fluorescence, and last but certainly not least, micropaleoichthyology.

Geo-chemistry has concerned itself largely with the determination of small concentrations of petroleum hydrocarbons in soil gases and the relationship between these and the prospective oil reservoir that may be down below. Geo-biology is interested in identifying the gaseous petroleum hydrocarbons by their effects on various species of bacteria. Fluorescence as the name implies, seeks to determine the presence of petroleum by the use of an ultra violet lamp, and the characteristic fluorescence produced. Micropaleoichthylogy, the youngest finding science of them all, is based on the prevalence of fish remains of various types and in relatively constant abundances in the respective geologic ages. In this particular case, the species are identified by fossilized segments that retain sufficient of their original character to render them identifiable under microscopic examination.

The pioneer in this new science is Dr. Lore Rose David who is now busily engaged in the laboratory of the Richfield Oil Corporation at Long Beach, searching out and classifying the tiny fish fossils that are the stock in trade of her abstruse art. At the moment, Dr. David is interested only in fossil scales, for it is on the basis of these members that she makes her correlations, but she is in reality an ichthyologist in the full meaning of the word. For a number of years she has been studying fish of all species and recording her findings for the benefit of science, and not so long ago she was engaged in a research project covering the habits and haunts of fish life in the Belgian Congo.

From her experience she has gleaned a wealth of interesting facts about the finny denizens that finally led her into the specific application of piscatorial knowledge in which she is now occupied.

It appears that just as every fingerprint has a distinctive series of whorls by which it can be identified, so every fish scale has its characteristic markings. The whorls on the scales are known as *annuli* and from these it is possible to tell fairly accurately the age of the fish, especially migratory fish. In the case of the salmon for example, which alternates between fresh and salt water, certain changes in scale contour and structure correspond with the environmental changes. It is not, as in a tree, a matter of one year or so many years per ring. It is the character of the rings rather than their number that tells the story. With that as an example it will



Dr. Lore Rose David is shown above recording the species and the count of scale fossils occurring in a core section. *Right*, scale from a modern flying fish. *Extreme right*, fossil scale of a flying fish.

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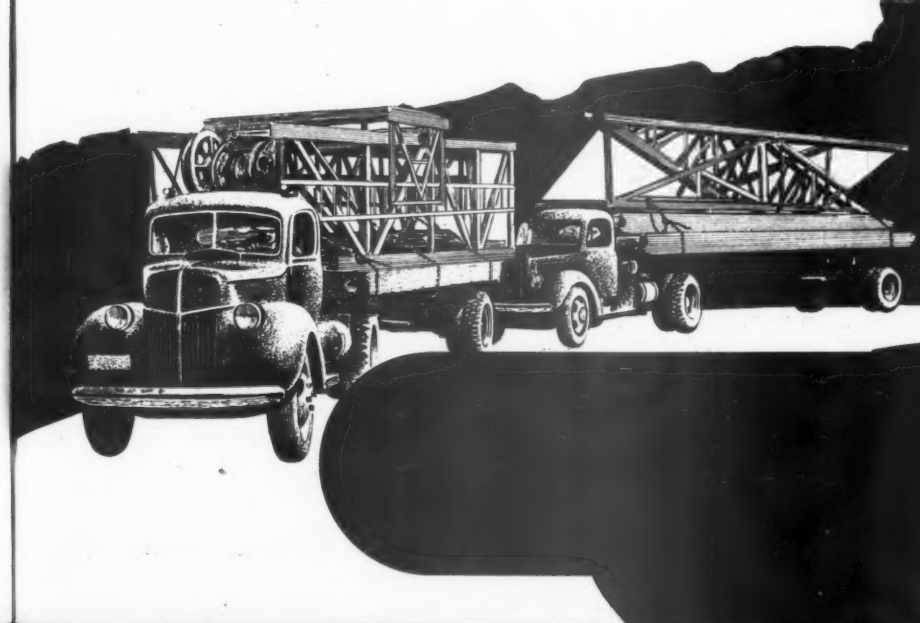

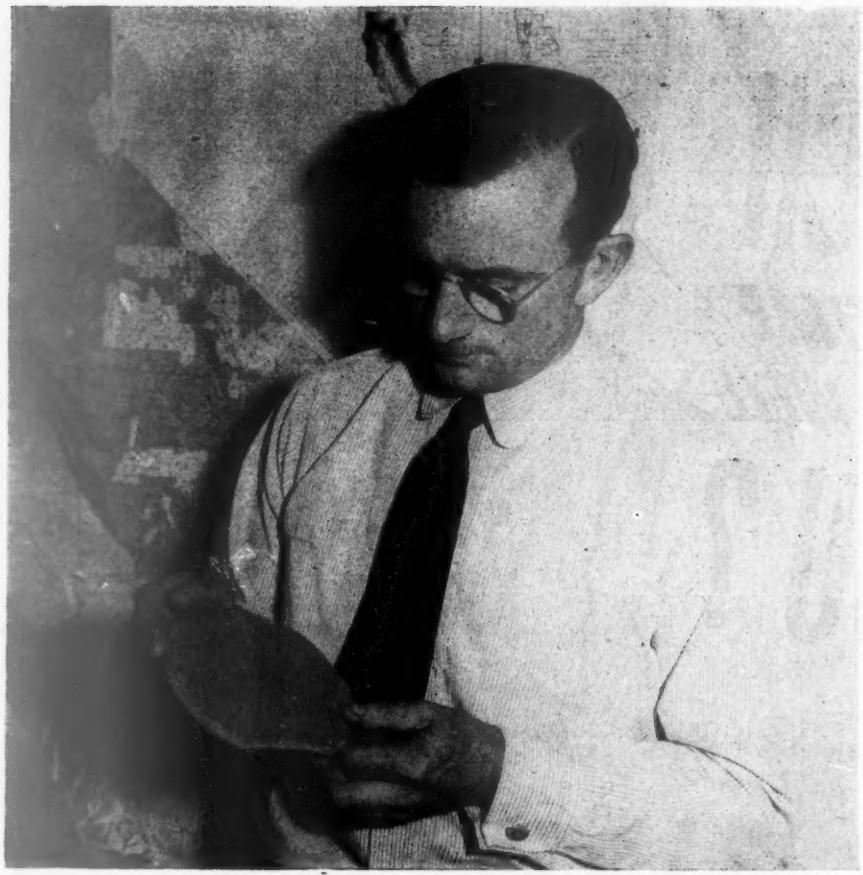

Dr. M. L. Natland, chief paleontologist, Richfield Oil Corporation, examines a core section for fossils.

be easy to understand how intense and continuous study might reveal all sorts of correlative factors. Dr. David has been peering at these minute bits of evidence so long that she is able to piece together quite a story about the behavior of the fish that originally carried them around. She can even tell of what their diet consisted in some instances.

This elementary exposition might lead to the supposition that the differentiation of species from an examination of the scale is a fairly simple matter to an ichthyologist, which is probably true in a general way, but after the scales have been buried under countless tons of earth and rock for a few million years, the identification becomes much more difficult. Add to this, also, that some of the species that lived in geologic ages may not be existent today and that if they are, they first have to be whittled out of the matrices in which they are embedded with the most meticulous care, in order to preserve the delicate markings, the convexities and concavities, and all the qualities and characteristics by which one genus might be distinguished from another.

In every step of the process, indeed, the utmost caution must be exercised to keep the specimen in good condition for the microexamination and subsequently for its possible preservation as a standard of a species. It might be pointed out, too, that whole scales are not always available, and the identification must be contrived from torn and distorted fragments.

It is obvious that the classification of the various species must be the work of one thoroughly familiar with all the variations and eccentricities of scale structure, after which the findings still require to be correlated with those of the geologists, paleontologists, and geophysicists. There is every reason to believe that this phase of the work is progressing very satisfactorily. The greater part of California's oil is found in marine sediments, so that all the fossils involved are of salt water fish, and the problem of the micropaleoichthyologist is to determine a relationship between the geologic strata and the numbers and types of fossil scales occurring in each.

Already it has been found that in certain formations in which foraminifera are conspicuous by their absence, fish scale fossils appear in considerable numbers. This permits a much more positive definition, for it is patent that to establish a stratum on the basis of what it contains is much more satisfying to the scientific mind than to identify it by what it doesn't contain. On the whole, the evidence is weighed in much the same way as that developed by the paleontologist. The various subsurface strata are defined either by their content of an individual type of fossil, a prevalence of certain types in approximately constant proportions, or by the abundance of specific types.

Complete fossilized skeletal remains are found in California, according to Dr. David, but usually only in the Upper Miocene. Fragmentary fossils, however, are located throughout the entire Tertiary section and to some degree in the Upper Cretaceous. In other subsurface sections they are altogether too sparce and distorted to be identifiable. Rich zones of occurrence, in which preservation is especially good and there is a wide diversity of form, are encountered. These are similar to the so called "flood zones" of foraminifera so well known to the paleontologist.

The fish scales seem to be best preserved in hard, shaly, diatomaceous deposits, and in the shale units of some formations, they are the most readily available fossils for correlation. Ordinarily they are large enough and sufficiently well differentiated to be identified in the field, and there are cases in which geological formations may, by the use of a small magnifying glass, be immediately defined, through the abundance of scale types that they contain.

It would appear, then, that fossil fish scales are sufficiently variegated to be used as markers for specific underground strata. They exhibit differences, due partly to facies changes and partly to anatomical evolutions that are the effects of time and environment. They can be used to check the zoning of the paleontologists on the basis of foraminifera, and they yield valuable information on the size and nature of ancient sea basins. Fish are faster swimmers than foraminifera and in the same space of time, therefore, become more widely distributed, so that they provide a time correlation over a much broader area. Dr. David is modest enough, however, to suggest that micropaleoichthyology, despite its preponderance of syllables, is up to the present time at least complementary to the other finding sciences, and serves best when fish scales are considered along with foraminifera.

Hundreds of species of fossil scales have already been identified and classified in the Richfield exploration laboratry, which is under the supervision of Dr. M. L. Natland, chief paleontologist. The work still goes on and there seems little reason to doubt that as correlations with the underground strata are expanded and further species of scale are identified, the project will attain greater significance as an aid in the oil finding art. Meantime, it is an interesting demonstration of the breadth of petrolic vision —that constant search for the better way that has kept the industry always in the forefront of scientific advance.

It should perhaps be mentioned in conclusion that Dr. Chester Stock of California Institute of Technology was the first to realize the possibilities of Dr. David's specialized knowledge. An authority on vertebrate faunas and with a deep interest in petroleum research, Dr. Stock excited certain oil companies into the institution of a fellowship at Cal Tech, so that Dr. David might advance her fish fossil studies. In the meantime she has published many scientific papers on the subject, and is still actively engaged in the development of this baby science with the big name—micropaleoichthyology. ★ ★ ★

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Graphical method for estimating CENTRIFUGAL PUMP IMPELLER SIZE AND SPEED

By **KENYON B. HOWARD,** Standard Oil Company of California

EXCLUSIVE

IN changing the service of a centrifugal pump it is frequently necessary to estimate the extent to which an impeller should be cut or enlarged, or to estimate a new speed at which the pump should run, or both. In the usual case a performance curve is available for the pump with a given impeller and at a given speed, and the pump must be altered to produce a new specified head and capacity that do not fall on the curve.

This calculation is made with the aid of the so-called "affinity laws" for speed change, or their counterparts for impeller diameter. These laws may be stated in words as follows:

A. For a pump with a given impeller:

1. Quantity pumped varies directly as the speed.
2. Head varies as the square of the speed.
3. Horsepower varies as the cube of the speed.

B. For a pump running at a given speed:

1. Quantity pumped varies directly as the impeller diameter.
2. Head varies as the square of the impeller diameter.
3. Horsepower varies as the cube of the impeller diameter.

These laws are stated later in mathematical form and their limitations are discussed. They may be found in any good engineering handbook.

The affinity laws are simple and easily understood, but difficulties appear in practice when they are used to determine a new impeller size or speed for a given head and capacity. Head and capacity change simultaneously, and one must choose some arbitrary point on the pump performance curve, apply the affinity laws, and see how close he comes to the required head-capacity point. After several trials, and at a cost of many minutes and some exasperation, a reasonably accurate answer can be obtained by this method.

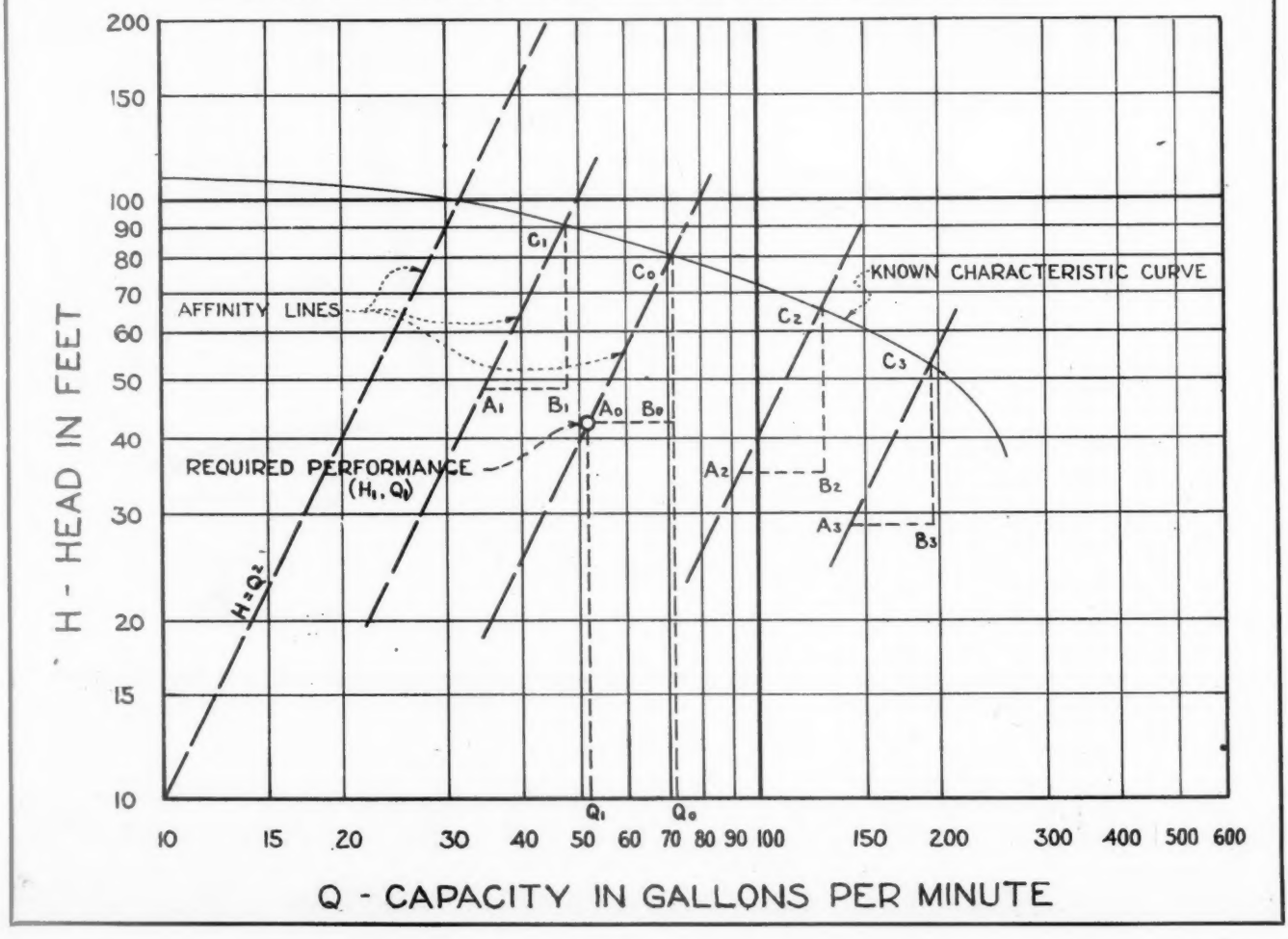
There is another method available for this calculation. It is quick, simple, and direct, as illustrated in the graph and described below. This method is based on the fact that the affinity laws can be plotted as a family of straight lines of definite slope on log-log graph paper.

The procedure is as follows:

1. Plot the known pump performance curve on log-log graph paper instead of the conventional square-ruled sheet.

2. Lay out an affinity line with a slope of 2 (parallel to the line $H = Q^2$) pass-

GRAPH FOR ESTIMATING CENTRIFUGAL PUMP IMPELLER SIZE AND SPEED.



PERFORMANCE

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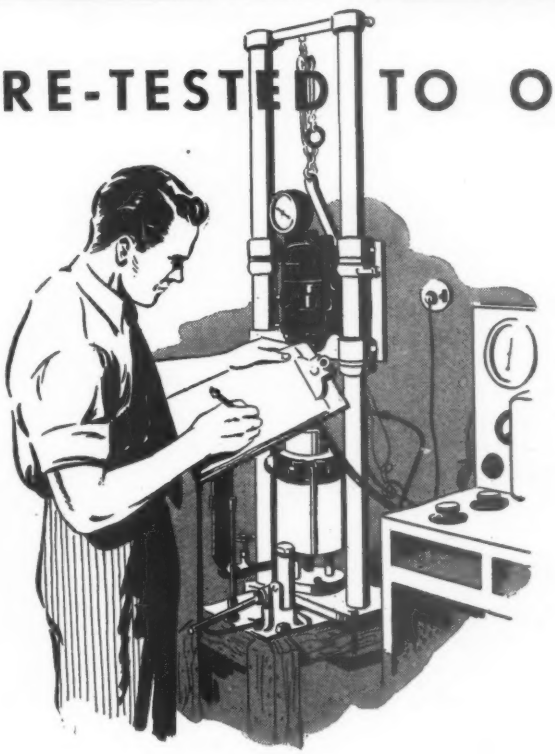

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ing through the required performance point (H_1, Q_1) and intersecting the known performance curve. Only two lines need be drawn, one to establish the slope, and the other parallel to the first, and passing through the required point.

3. Read the capacity Q_0 corresponding to the intersection of the affinity line and the performance line. Form the ratio Q_1/Q_0.

This ratio Q_1/Q_0 is the ratio of the required to the given impeller diameter, or the ratio of the required to the given pump speed. The power to drive the pump varies in the ratio of $(Q_1/Q_0)^3$.

As an example of the graphical method, consider a pump with a 12-in. impeller and head-capacity characteristics (at operating speed) as shown in the illustration. It is required to cut the impeller so that a delivery of 52 gal. per min. will be obtained against a difference in head of 42 ft. Following the procedure outlined above, point c_0 is found on the known curve, representing a capacity of 72 gal. per min. The capacity ratio is then 52/72 or 0.722, and the required impeller diameter is 0.722×12, or 8.66 in. The horsepower ratio is $(0.722)^3$ or 0.376.

If the speed were to be reduced but the original impeller retained, the new speed would be 52/72 of the old, and the power required would decrease to 0.376 of its original value.

The graphical method presented here rests on the basic assumption of the affinity laws. This implies constant efficiency, and it further implies that suction conditions will permit the pump to operate at the desired point. The affinity laws are satisfactorily accurate over a speed range of two to one or more, but must be used with caution in estimating impeller size cuts. In practice impellers are seldom cut to less than 80 per cent of the maximum design diameter, and 70 per cent represents about the minimum usable size. The calculated size will be about 3 per cent too small at 80 per cent, and about 5 per cent too small a 70 per cent. In any case, if the impeller is cut down so far that the vanes no longer overlap at all radii, performance becomes unpredictable. Changes in impeller shape, of course, such as under-filing the vane tips, will alter the performance of the pump in a manner that is not predicted by the affinity laws.

The accuracy of the affinity laws for speed change is an important attribute, and the calculation method presented will enhance their usefulness as working tools in the development of practical variable speed operation of motor-driven centrifugal pumps.

The affinity laws may be stated in equation form as follows:

At constant speed:

$$\frac{Q_1}{Q_0} = \frac{D_1}{D_0} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\frac{H_1}{H_0} = \left(\frac{D_1}{D_0}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\frac{P_1}{P_0} = \left(\frac{D_1}{D_0}\right)^3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

At constant impeller diameter:

$$\frac{Q_1}{Q_0} = \frac{S_1}{S_0} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

$$\frac{H_1}{H_0} = \left(\frac{S_1}{S_0}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

$$\frac{P_1}{P_0} = \left(\frac{S_1}{S_0}\right)^3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Where: Q = quantity pumped, H = difference in head, P = power required, D = impeller diameter, and S = pump speed.

Squaring equation 1 and substituting in equation 2 gives

$$\frac{H_1}{H_0} = \left(\frac{Q_1}{Q_0}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

which may also be written

$$H = KQ^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Equation 8 when plotted on log-log paper is a family of straight lines with a slope equal to the exponent, in this case 2. These straight lines may be called "affinity lines" and are entirely general for centrifugal pumps as long as the affinity laws apply.

It will be noted that a complete new characteristic curve for the pump, with its altered impeller or speed, may be constructed by drawing a smooth curve through points a_0, a_1, a_2 . . . a_n. These points are located by constructing identical triangles $a_0b_0c_0$, $a_1b_1c_1$, $a_2b_2c_2$ . . . $a_nb_nc_n$ as illustrated. ★★★

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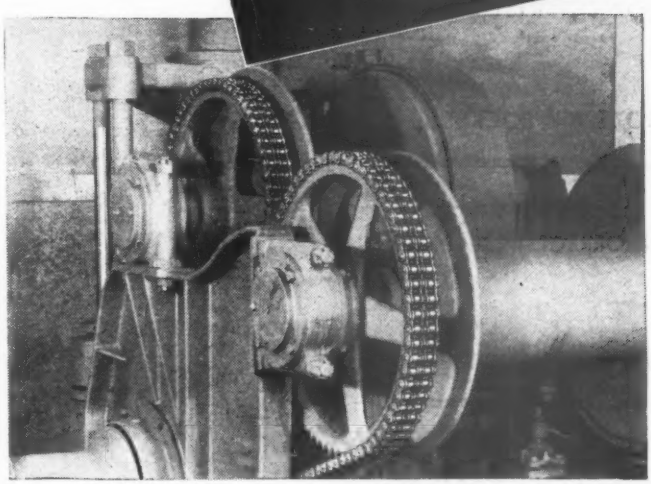
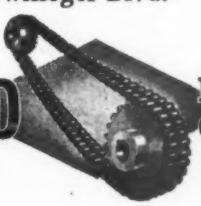


Hoisting Drum driven by ¾" pitch double Chain
Sand Reel driven by ¾" pitch double Chain



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(Conclusion)

EXCLUSIVE WHENEVER the pump, or driver, or both, are heated in operation, the unit should be properly aligned under these conditions. This is necessary due to changes in alignment resulting from the expansion from the cold to the hot conditions.

Both suction and discharge pipes should be independently supported near the pump so that when the flange bolts are tightened no strain will be transmitted to the pump casing.

Thinking of pipe weight as pure vertical pressure on a pump is dangerous thinking. Actually the length of piping stretching away from the pump is apt to exert a terrific leverage on it and may break the flange or casing nozzle.

To take a specific example: Suppose a 3-in. pump with a 4-in. suction has a 4-in. by 6-in. swedge, a flange union, a nipple, an ell, and 8t ft. of unsupported pipe on it. These connections, if cement-lined, may weigh 180 lb. The pump bracket and the pump coupling have a lever 8 ft. long and 180 lb. trying to pry it off the foundations. This pump is bolted to the foundation by four ½-in. bolts spaced 12 in. one way and 14 in. the other way. If the pump housing or pedestal has not been broken, the coupling probably has been pried out of line.

Rule: When a pump installation is made, all piping should be in place and self-supporting before connecting the pump.

The pump connections should never be bucked into the pump. It is criminal to use a pump as a "buckup" to screw in a connection.

It is usually advisable to increase the size of both suction and discharge pipes at the pump connections in order to decrease the loss of head from friction, and for the same reason piping should be arranged with as few bends as possible and these should be made with a long radius wherever possible.

A check valve and a gate valve may be installed in the discharge line. The check valve, placed between the pump and the gate valve, is to protect the pump from excessive back pressure and to prevent water running back through the pump in case of failure of the driving machine. The gate valve is used in priming and starting and when the pump is to shut down. It is advisable to close the gate valve *before* stopping the pump when a foot valve or check valve is installed to prevent water hammer. This is especially important when the pump is operated against a a high static head. When a pump is operated on a float switch, it is advisable to install a surge chamber in the discharge line, and connect the check valve rigidly and install a flexible connection between the check valve and the pump. On pumps operating at 30-lb. pressure, hydraulic hammer as high as 150 lb. has been noted.

On an automatic water system where a foot valve is used to keep the pump primed, the check valve should be omitted from the discharge line to prevent the pump from losing its prime if a slight leakage of the foot valve should occur. This practice is not advisable for a pump with 2 in. or larger discharges.

The suction pipe must be kept free from air leaks. This is particularly important when the suction line is a long one or the static suction lift is high.

Trouble is often caused by the use of bell and spigot pipe in the suction line. Screwed or flanged pipe is recommended for the smaller sizes and flanged for the larger sizes or for high suction lifts.

The suction pipe should slope upward to the pump suction. A horizontal suction line must have a gradual rise to the pump. If other piping is in the way, go under it. Any high point in the pipe will become filled with air and thus prevent proper operation of the pump. *A straight taper reducer should not be used in a horizontal suction line,* as it forms an air pocket in the top of the reducer and the pipe. Use an eccentric reducer instead. If an air pocket is left in the suction pipe when the pump is primed it will often start up and pump properly for a time, but it is probable that a quantity of air will be drawn from the air pocket and up into the pump, causing the pump to lose its prime. This is especially true when the pump is primed by the use of a foot valve. But even when it is primed by ejector or vacuum pump a small quantity of air is left in the pocket and this is added to, both from air in the water released by the partial vacuum in the suction pipe and from air admitted through minute leaks in the pipe connections that ordinarily would not cause trouble. Small air pockets that may cause trouble are formed in the top of any gate valves installed vertically in the suction line. It is recommended that the gate valves in the suction line be laid so that the stems are horizontal. Trouble caused by an air pocket in the suction line can usually be stopped temporarily by priming and starting the pump several times. This will draw out enough of the air in the pocket so that the pump will operate properly, but the trouble is likely to recur, and such a pocket should be eliminated.

Check valves ordinarily should have no place in the suction line, although

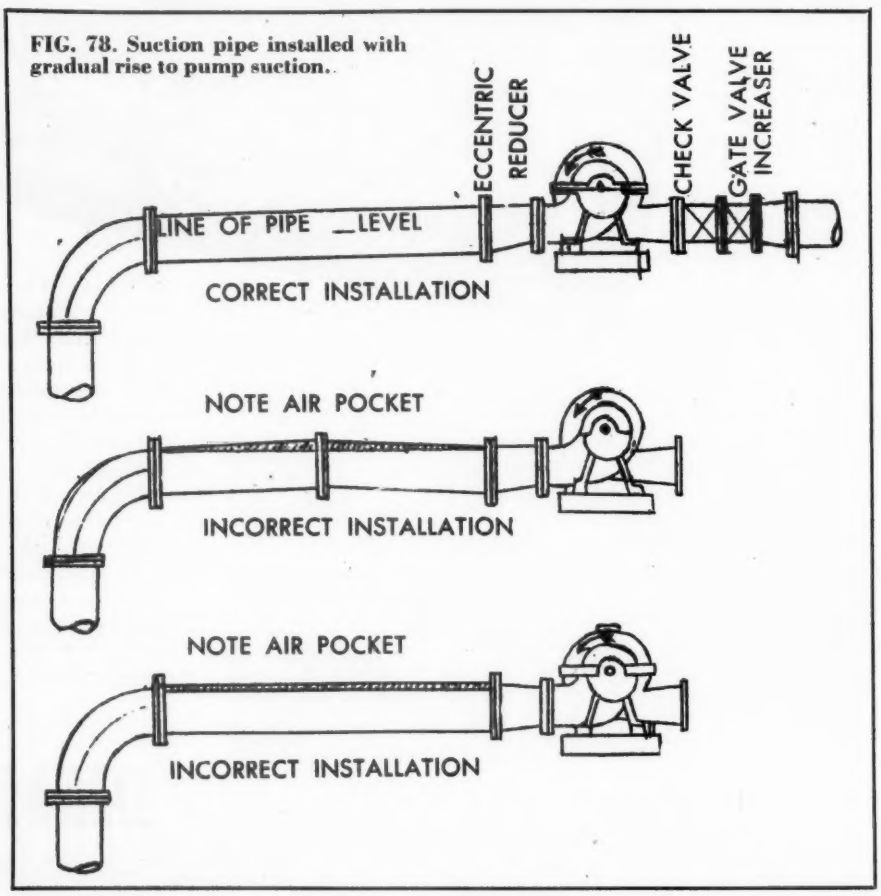

FIG. 78. Suction pipe installed with gradual rise to pump suction.

PC *higher*

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they are sometimes used in series-parallel operation to reduce the number of valves that are to be operated when changing from series to parallel operation. *The pump must not be throttled by the use of a valve on the suction side of the pump.* Suction piping should not be installed so that there is an elbow close to the suction of the pump except when this elbow is in a vertical position. An elbow bending either straight up or straight down is permissible, but one entering at another angle should not be used. There is always uneven flow around an elbow and when it is installed in any but a vertical position, this unequal flow causes more water to enter one side of the runner than can enter the other side, thus causing a thrust that will heat the thrust bearing and possibly be of sufficient magnitude to cause rapid wear of the bearing.

When the suction lift is not very high it is frequently advisable to install a foot valve to facilitate priming. Foot valves should not be used when the pump is operating against a high static head, as failure of the power would allow the water to rush back, suddenly causing a heavy water hammer. The foot valve should be of the flap type rather than of the multiple spring type with a clear passage for water of at least the same area as that of the suction pipe. Care must be taken to prevent foreign substances from being drawn into the pump or choking the foot valve, and for this purpose an efficient strainer should be provided. When there are things such as sticks, twigs, leaves, etc., in the water a larger outside screen should be placed around the suction inlet to prevent choking the strainer. This screen should have sufficient openings to keep the flow through it to less than 2 ft. per sec.

Care should be taken to prevent the pump from freezing during cold weather when it is not in operation. It may be necessary, when there is any possibility of this, to drain the pump casing of its water during the shut-down period by removing the plugs in the bottom of the casing and suction passage.

Before starting the pump the casing and suction line must be filled with water. The pump must not be run unless it is completely filled with water, as there is danger of injuring some of the parts of the pump that depend upon water for their lubrication. Wearing rings will not seize when the pump is filled with water but are very likely to do so when the pump is run dry. The pump may be primed in a number of ways. The pump must not be started without being primed. Be sure that the driver rotates in the direction indicated by the arrow on the pump casing.

The stuffingboxes are ordinarily packed before shipment. If, however, stuffingboxes are not packed, they should be carefully cleaned and the packing placed in them. Be sure that sufficient packing is placed back of the water seal ring so that the water for sealing is brought in at the water seal ring and not at the packing. The piping supplying the sealing water should be fitted tightly so that no air is brought in, as a small quantity of air entering the suction at this point may result in the pump losing its suction.

In placing the packing, each packing ring should be cut to the proper length so that the ends come together but do not overlap. The succeeding rings of packing should be placed in the stuffingbox so that the joints of the several rings of packing are staggered. The packing should not be pressed up too tight, as this may result in burning the packing and cutting the shaft. The stuffingbox is not properly packed if friction in stuffingboxes prevents turning the rotor by hand. On starting the pump it is well to have the packing slightly loose without causing an air leak. Rather than put too much pressure on the gland, if it seems to leak, put some heavy oil in the stuffingbox until the pump works properly and then gradually tighten up the gland. The packing should be changed occasionally. Extreme care should be taken to allow the packing to set gradually. On high speed glands, it is possible for the gland to seize and raise the temperature of the sleeve to 500°F., in 5 min. This will expand the sleeve and tend to push the impeller and impeller nut off the shaft. Immediate damage will result. If this does not happen, the sleeve will expand and allow foreign matter to creep between the sleeve and the shaft. This opening will allow water to leak by. Excessive vibration will cause the shaft to break.

As packing boxes are water sealed, be sure that the water seal valves are sufficiently open to allow a slight leakage of water, but not open so much that the gland has to be drawn tight to prevent excessive leakage. This leakage should be piped away to a sump.

All pumps for general service are shipped packed with the highest grade of soft, square asbestos packing, impregnated with oil and graphite.

When selecting packing special care should be exercised to procure a soft, well-lubricated packing to reduce stuffingbox resistance to the minimum and prevent excessive wear on the shaft sleeves.

Some companies are now making a plastic packing that will eliminate many packing troubles. It will come in a ball form and will be pressed into the gland by hand. It will have some compression qualities. This packing when available for general use will materially aid in the elimination of gland troubles.

Pumps equipped with grease lubricated ball or roller bearings have the bearings packed with grease in the factory and ordinarily require no attention before starting providing the pump has been stored in a clean dry place prior to its first operation. After the pump has been started the bearings should be watched the first hour or so to see that they are operating properly.

The importance of proper lubrication of ball bearings cannot be overemphasized. It is difficult to say how often a ball bearing should be greased, for this depends upon the conditions of operation. It is well to add 2 or 3 oz. of grease at regular intervals, but is very important to avoid adding too much grease. Excess grease will leak out the end of the bearing and is the most common cause of overheating of ball bearings. *For average operating conditions it is recommended that grease be added at intervals of 3 to 6 months.* Great care should be used in greasing ball bearings. More bearings have been ruined by over greasing than under greasing. Allow the motor to run when greasing a bearing. Pull the drain plug. Pump roller bearing lubricant onto the bearing until grease comes from the drain plug. Replace the plug. This will prevent overheating the bearings.

Before starting a pump equipped with sleeve bearings, clean the bearings thoroughly as dirt and foreign matter may get in during shipment or erection. The bearings should then be filled with a medium neutral mineral base oil of SAE No. 20 grade. This oil is quite satisfactory. It should be changed when it becomes dirty and the bearings cleaned at the same time. The bearings should be examined for wear at frequent intervals. When the pump is first started the operator should make sure that the oil rings are turning freely. They may be watched through the oil holes in the bearing caps. During the first hour of operation they should be watched to see that they are operating properly. Instructions covering oil-lubricated sleeve bearings also apply to oil-lubricated ball bearings and the grade of oil should be the same.

If it is desired to examine a split case

Exports double imports

The United States in the first half of 1945 exported more than twice as much petroleum as it imported, official figures reveal. Exports comprised about 12 per cent of the total demand made on the industry whereas imports provided slightly more than 5 per cent.

Imports and exports both increased in the 6-month period in comparison with the corresponding 1944 period. In the 1945 period, imports were 53,000,000 bbl. of which 31,000,000 bbl. were crude and 22,000,000 bbl. refined. In the 1944 period, imports totaled 45,000,000 bbl., made up of 19,000,000 bbl. crude and 26,000,000 bbl. refined. Exports in the first half of 1945 were composed of 14,000,000 bbl. crude and 98,000,000 bbl. refined, for a total of 112,000,000 bbl.; in 1944, crude 16,000,000 bbl. and refined 81,000,000 bbl. for a total of 97,000,000 bbl.

RUGGED POWER

MURPHY DIESELS permit efficient use of limited space . . . they allow a good compact installation and still provide plenty of room to get around each engine . . . as shown in the above twin installation on a Model U-10 Unit Rotary Drilling Rig. The engines are Model ME-66, 6 x 6½, 6-cylinder Murphy Diesels . . . they drive through air-o-matic clutch to compound. Rugged and powerful heavy-duty engines, but relatively light in weight and unusually compact, Murphy Diesels have won many friends in oil field service by their ready adaptability to a wide range of work on which they are dependable and economical, requiring no premium priced fuel . . . easy to start, simple to operate. . . . Write for bulletin.

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204

pump remove the nuts from the bolts and studs in the flange around the casing and take out the dowels. The upper half casing may now be lifted off. The impeller may be turned by hand for inspection.

Most multistage pumps are equipped with a gasket of 1/64-in. thick service sheet. When assembling pump a gasket of same thickness as originally supplied should be used.

To remove coupling bolts, back the nuts partly off from the coupling bolts. Then drive the coupling bolts out by striking the end of the nuts, or remove the nuts and drive the coupling bolts out with a piece of soft metal.

To remove rotating element, remove bearings and upper half of casing as explained above. Remove coupling bolts. Remove glands, packing and water seal rings. The rotating element consisting of shaft, impeller, wearing rings, sleeves, etc., may now be lifted out.

Wearing rings are fitted in the casing and usually on the impeller around the inlet to reduce the quantity of water leaking back from the high pressure side of the suction. These wearing rings are fitted with a small clearance and depend on the water in the pump for lubrication. They will eventually wear so that the clearance becomes greater and more water passes back into the suction. The rate of wear depends on the character of the water pumped. Wearing rings may be replaced when worn. Those on the impeller can be cut in two with a cold chisel and removed. New impeller wearing rings should then be heated just sufficiently so as to place them easily in their proper positions and then allowed to cool.

To remove coupling, use a coupling puller and pull the coupling from the shaft.

To remove impeller, shaft sleeves, etc., remove the rotating element. Remove thrust sleeve, set collar or ball bearings. Remove shaft sleeve nuts. Hold shaft vertically and allow it to drop on a block of wood a number of times so that the weight of the impeller will force it and the shaft sleeve off the shaft. When replacing, paint the shaft with white lead and oil to prevent leakage of air along the shaft to the inlet of the impeller, and replace the packing between sleeve and nut.

While investigating causes of trouble with centrifugal pumps bear in mind that every centrifugal pump has been tested for its capacity and head rating at the factory before shipment, and has been found to meet the guarantees and was also mechanically correct. Discounting the possibility of damage during shipment, most of the trouble in the field is due to faulty installation. If the following points are checked, therefore, it is very likely the difficulty can be discovered and remedied:

1. No water delivered.
   a. Priming (pump and suction piping is not completely filled with water before starting.)
   b. Speed too low.
   c. Discharge head too high.
   d. Suction lift too high, check with gages.
   e. Impeller completely plugged up.
   f. Wrong direction of rotation.
2. Not enough water delivered.
   a. Air leaks in suction or stuffing-boxes.
   b. Speed too low.
   c. Discharge head higher than anticipated.
   d. Impeller partially plugged up.
   e. Mechanical defects — wearing rings worn, impeller damaged, casing packing defective.
   f. Foot valve too small or partially obstructed.
   g. Foot valve not immersed deeply enough.
   h. Wrong direction of rotation.
3. Not enough pressure.
   a. Speed too low.
   b. Air in water.
   c. Mechanical defects — wearing rings worn, impeller damaged, casing packing defective.
4. Pump works for a while and then quits.
   a. Leaky suction line.
   b. Water seal plugged.
   c. Suction lift too high.
   d. Air or gases in liquid.
   e. Suction piping and valves not completely freed of air when priming, viz., air can collect in high points in suction line, valve bonnets, etc.
5. Pump takes too much power.
   a. Speed too high.
   b. Head lower than rating, pumps too much water.
   c. Liquid heavier than water. Check viscosity and specific gravity.
   d. Mechanical defects: Casing distorted due to excessive strains from suction or discharge piping; shaft bent; impeller rubs in casing; rotating element binds; stuffingboxes too tight; wearing rings worn; casing packing defective.
   e. Wrong direction of rotation.
   f. Coupling out of line.

TABLE 8. Potentials of metals in contact with salt solutions.

Electromotive series

Lithium	Li		−3.02
Potassium	K		−2.92
Barium	Ba		−2.8 (?)
Sodium	Na		−2.72
Calcium	Ca		−2.5 (?)
Magnesium	Mg		−1.55
Aluminum	Al		−1.34
Manganese	Mn	(Mn++)	−1.0 (?)
Chromium	Cr	(Cr++)	−0.6 (?)
Chromium	Cr	(Cr+++)	−0.5 (?)
Iron	Fe	(Fe++)	−0.43
Cadmium	Cd		−0.40
Nickel	Ni	(Ni++)	−0.22
Tin	Sn	(Sn++)	−0.14
Lead	Pb	(Pb++)	−0.13
Iron	Fe	(Fe+++)	−0.04
Hydrogen	H_2		0.00
Antimony	Sb		+0.1 (?)
Bismuth	Bi		+0.2 (?)
Arsenic	As		+0.3 (?)
Copper	Cu	(Cu+)	+0.34
Copper	Cu	(Cu+)	+0.51
Mercury	Hg	(Hg+)	+0.79
Silver	Ag		+0.80
Mercury	Hg	(Hg++)	+0.86
Gold	Au	(Au+)	+1.5 (?)

When direct connected to electric motors, check up whether motor is across-the-line and receives full voltage.

Pumps can be made of almost any metal or combination of metals. Several combinations seem to offer good resistance to salt water corrosion.

Iron, copper, zinc, lead, tin, nickel, chromium, molybdenum, silicon, phospherous, porcelain, rubber, manganese, aluminum, enameled or stoneware, carbon, and illium have all been used for pumps for various services.

In order to prevent electrolytic corrosion all water contacts of a pump should be made of the same metal. In this way, the flow of current between two different metals will be partially eliminated. All metals have been placed in what is known as the electro-motive series.

If a pump cannot be made of identical material, parts should be chosen so that they come as close to each other as possible in the electromotive series. For instance, it would not be proper or feasible to install a bronze impeller in a cast-iron pump. A ni-resist impeller should be chosen. Ni-resist is cast-iron with a small percentage of nickel. Consequently its place in the electromotive series will be next to that of cast-iron.

It is well to note that all cast-iron will not have the same electromotive potential. This is caused by the fact that the cast-iron will not have exactly the same chemical formula.

Here are the chemical analyses for some of the special alloys that have been used for pumps:

Naval bronze, 60 per cent copper, 39.25 per cent zinc, 0.75 per cent tin;

Zincless bronze, 88 per cent copper, 2 per cent lead, 10 per cent tin;

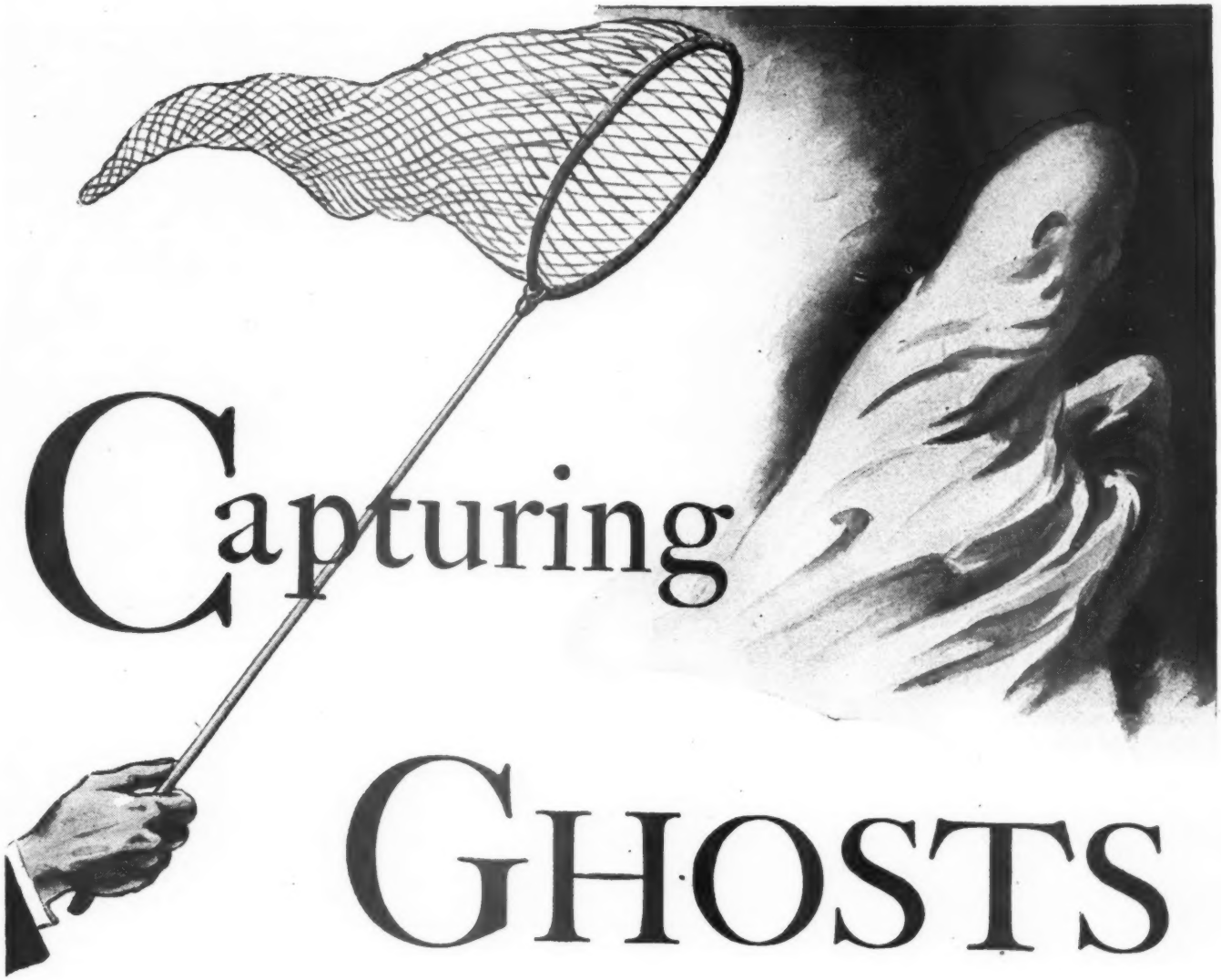
Worthite, 24 per cent nickel, 20 per cent chromium, 3 per cent molybdenum, 3.5 per cent silicon, 2 per cent other elements, 47.5 per cent iron.

Ordinarily an all-iron 1½-in. centrifugal pump will cost about $36, but if the motor, skid, coupling, and starting equipment are considered, this will run the price up to $217. If ni-resist impeller and stainless steel shaft is specified it will increase the price by approximately $10. Our tests are beginning to show that this extra $10 will increase the life of the pump by at least twice. If a 1½-in. pump has to be changed, two men will usually average about 3 hr. time and have to drive several miles to do the work. This cost will amount to approximately $15.

The extra cost of special bronze pumps will be about $45 for a 1½-in. pump to $250 for a 6-in. pump.

The cost of Worthite over the cost of a complete all-iron pump will be about 50 per cent. Worthite is a very hard, tough metal. It is difficult to cast and hard to machine. This "hard-to-work" characteristic is the main reason for the cost of the pump. It is not entirely the cost of the metal itself.

The Worthite metal pumps have been installed long enough to prove their ability to handle and to keep on handling salt water.



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WE transform "ghosts of ideas" into practical, useful realities which the oil industry can use profitably.

This is often a long and painstaking proceeding. Most new ideas start as untried possibilities surrounded with obstacles and difficulties.

Several years of research and experimentation may be needed to make the idea work, to eliminate difficulties, to design and redesign the equipment, to determine procedures and costs, to develop control and metering devices, and to work out processes for the recovery of by-products and reactants.

Complex patent situations may have to be studied and practical solutions worked out.

Finally the idea must be commercialized by relating it to other oil industry practice and demonstrating its special advantages.

Then, and only then, can an idea go to work . . . cutting costs, improving quality, increasing volume of production . . . for the benefit of the industry.

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Water is of tremendous importance to railroads! A shortage—or failure of water supply can play havoc with schedules. Maintenance engineers on practically all of America's major railroads have long insisted on—and use Layne Well Water Systems. These experienced men can—and do place absolute confidence in Wells and Pumps built by Layne. No other kind has yet won their full approval.

The reason of such broad and overall preference is almost too obvious to mention. In advanced engineering design alone, Layne Well Water Systems are far ahead of competitive makes. But it is the genuine rugged quality and long trouble free life of Layne water producing equipment that wins and holds the grateful thanks of all owners.

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LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

The special bronze pumps have been doing a good job. Only one of them, the Naval Bronze, has been in long enough to get a fair trial. This unit is handling chlorinated water carrying up to 2.0 ppm. of residual chlorine. It was installed in December, 1943. It has recently been inspected and found to be in excellent condition. Naval Bronze has about the same chemical analysis as Tobin Bronze, though some of the characteristics are slightly different.

CHAPTER IV

The Closed Type of Salt Water Disposal

DEFINITION: A closed brine injection or disposal system is just what the word implies. It is a method for handling oil-field brines without exposure to the atmosphere or sunlight *from* the formation producing the brine (whether with oil or not) *to* the subsurface formation taking the brine. The brine may or may not be subjected to chemical or mechanical treatment; this depends entirely upon the particular problem involved.

OBJECTIVES:

(1) Minimizing of corrosion by exclusion of oxygen from brine, in many cases, permits use of ordinary common steel vessels, pipe and fittings throughout the whole system.

(2) Exclusion of atmospheric oxygen stifles growth of areobic (air-requiring) bacteria, which if allowed to grow and multiply would contribute greatly to plugging of the injection well.

(3) Exclusion of atmospheric oxygen permits continued solution of many minerals in the brine (such as iron, calcium, and magnesium) thus rendering them passable with the brine into the injection formation. In many cases this eliminates the need for elaborate filtering facilities.

(4) Exclusion of atmospheric oxygen and sunlight stifles the growth of certain undesirable plants such as algae which if allowed to go unchecked can do great plugging damage to an injection well.

● **Gathering system.** *Water separation.* In practically all cases the brine is closed from the atmosphere from the time it is produced at the well, through the oil and gas separator and *to* the oil and water separating or treating system. At this point it is often subject to exposure to atmospheric oxygen in the commonly used gun barrel or settling tank. An ideal closed system would employ a closed type pressure operated treating plant at this point, although a properly equipped gun barrel or settling tank could in many cases prove adequate. These tanks should have an appreciable amount (several ounces) of hydrocarbon gases on them at *all* times, whether lease production is continuous or not. The water outlet syphons should be vented into the gas space of the tank, rather than to atmosphere, and the oil outlet to the stock tanks should be provided with a liquid seal dump valve or gooseneck. Some operators might find it suitable to install a pressure operated free water knockout ahead of the gun barrels, between the heater and the gun barrel. If the lease is making considerable water, then it is likely that little or no heat is required, in which case a baffled excelsior water knockout ahead of the gun barrels would be pertinent for removal of water from the oil and thorough removal of oil from the water. Such knockouts are available on the market at this time. A gas atmosphere may be maintained on the treating tank by use of gas tight thief hatches and back pressure valves on the tank stack or vent line. For tanks that have shutdown periods, gas may be brought in from an outside source and passed to tank through a low-pressure regulator. If this gas is residue from a gasoline plant, it should be kept in mind that this gas often contains considerable oxygen that may be removed by passing gas through a solution of pyrogallic acid.

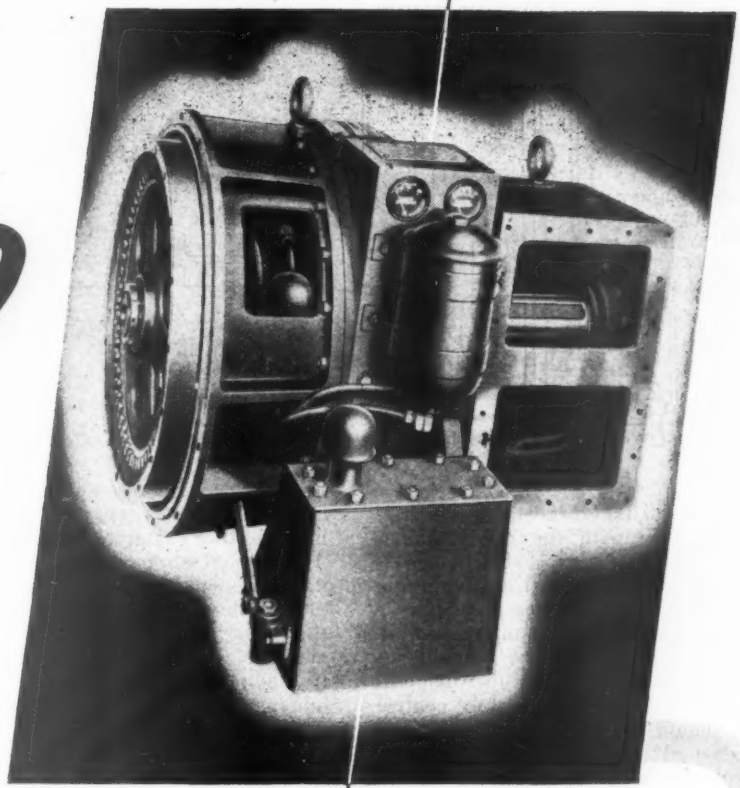
From oil-water separation to disposal plants. Whether leaving a pressure-operated emulsion treater, water knockout or gun barrel with gas atmosphere, the brine pursues the same course. It leaves the oil-separation vessel through an automatic dump valve or gas vented syphon water leg and, in most cases, enters a plain steel pipe that carries it to the brine disposal system directly. In cases where several leases are tied to one disposal system and where some of them will not reach the system by virtue of gravitational head and their own pressures, then brine from these may be piped to individual or collective receiving tanks equipped with gas atmospheres and float controlled automatic pumping equipment. In most cases all this equipment may be made of standard steel materials, or whatever is available.

● **Disposal plant facilities (surface). Non-chemical system.** *Filter-skimmer.* From the oil-water treating system the brine goes first to a filter-skimmer at the brine disposal site. The purpose of this pressure vessel unit is described in the name. By use of suitable baffles (there are several designs on the market) all remaining oil that is possible to be removed is removed. Then the brine is passed through some sort of filtering medium, which may be sand, excelsior, or any other suitable medium. This is to remove any entrained solids that may have inadverently precipated or that may have been in the brine from its source. If much of these solids are present, a sand filter with backwashing facilities should prove superior to excelsior. Otherwise, if little is present, then excelsior may be used and simply changed at suitable intervals. The brine is now ready for injection, but it must pass to a surge tank for proper and controlled introduction into the injection well. Accumulated oil in filter-skimmer may be bled off manually, or overflowed through a dump valve as it accumulates.

Surge tank for well. From the filter-skimmer the brine passes through a water leg outlet that automatically maintains a constant oil-water level in the filter-skimmer vessel. From this water

LOOK BEYOND

the Original Cost



When you figure the cost of a drilling rig, look beyond the *original* outlay. Consider the *cost per day of operation* . . . the cost of overall maintenance, replacements and repairs in relation to the amount of *work done*.

When your drawworks is equipped with a Twin Disc Hydraulic Torque Converter*, you can be sure of reduced overall maintenance. The hydraulic feature of the torque converter provides a "cushion" that absorbs destructive shocks and strains . . . appreciably lengthens the life of lines, cables and other allied equipment. You can count, too, on less time wasted . . . more feet drilled . . . with the Twin Disc Hydraulic Torque Converter. The converter provides a smooth, flexible flow of power . . . eliminates fixed "steps" or reduction ratios . . . automatically selects the proper torque-speed ratio for any given load.

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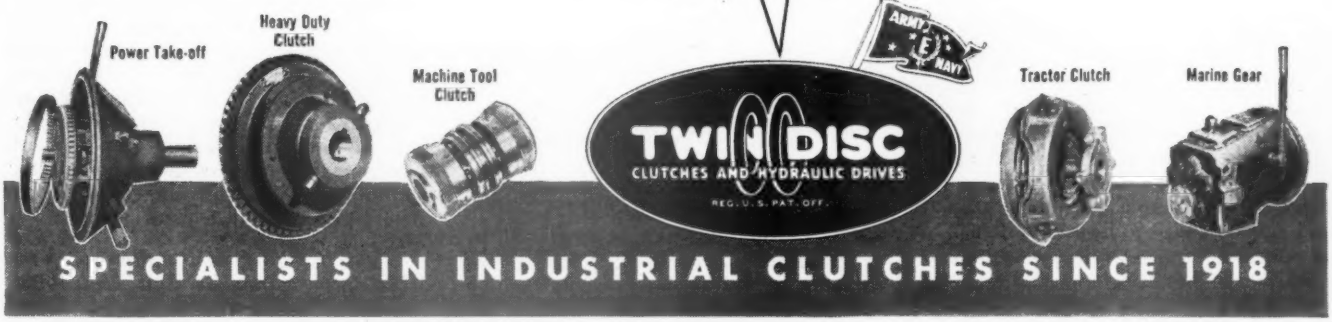
**Lysholm-Smith type.*



SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

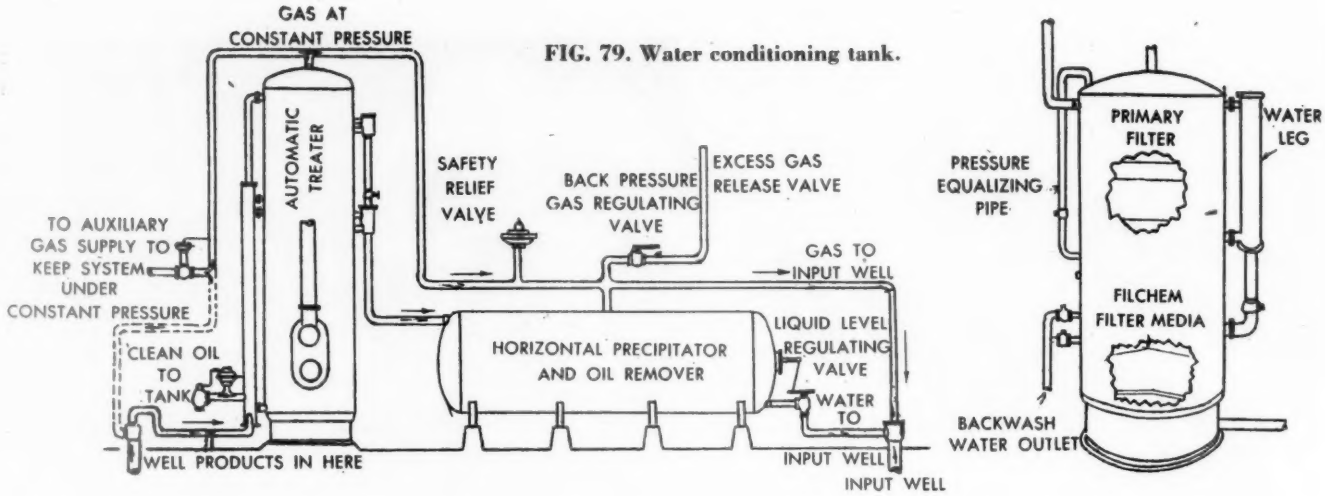


FIG. 79. Water conditioning tank.

leg it goes to the surge tank, which is gas equalized with the filter-skimmer vessel. The surge tank is simply a pressure-type vessel with float or diaphragm motor valve controls for actuating a pump to pump brine into injection well. In cases where the well is capable of taking more water than the disposal system supplies it, a subsurface control valve should be used in the well, this valve actuated by the same surge tank controls that would be used to actuate a pump.

Bacterial control. Although this is under the heading of non-chemical system (because all minerals are left in solution) it may prove essential to consider bacteria control even in this type system. In some waters, especially East Texas brines, the mineral and organic compounds are such that sulphate reducing bacteria find perfect conditions for abundant growth even in the absence of light and oxygen. It has been propounded by many, including the writer, that short retention of the brine should prove effective in preventing stagnation of the brine and cut short the incubation period for the bugs, all of this achieved by use of comparatively small vessels and rapid flow of brine through the whole system. This theory has been dealt a mortal blow in recent months by definite proof that these bacteria can cling and grow on pipe surfaces where there is even turbulent flow of brine that has never been subjected to stagnation or delay once it is produced from the well. This being the case, in localities where sulphate-reducing bacteria do thrive in a closed system there is but one alternative known; that is to use some sort of nonoxidizing means to kill or stifle the reproduction of these bacteria. Considerable research is being made on this particular problem at this time, but the results are not wholly conclusive or final. A nonoxidizing means must be used in order to permit retention of soluble unoxidized minerals such as iron in solution in the brine. It might be noted that where they exist, these bacteria prove highly troublesome in both open and closed types of disposal systems.

● **Chemical type closed system.** *Filter-skimmer.* The filter-skimmer in this type system is very similar to that of the non-chemical closed system especially wherein removal of entrained oil is concerned. After the oil is removed, suitable precipitants, depending wholly on the nature of the brine to be handled, are added to the brine to precipitate the unstable minerals. These chemicals may be caustic compounds or oxidizing agents or others. In any case these precipitants must be filtered out and a conventional sand filter is often used with facilities for backwashing. As one of the main purposes of a closed system is to avoid excessive filterings and settlings, the chemical closed system somewhat defeats the main object. Also, the use of chemicals, especially the oxidizing types, brings in the hazard of corrosion, which the closed system was designed to obviate.

The surge tank. The surge tank for the well is the same for both chemical and non-chemical closed systems.

The bacteria problem is similar in both systems, for all the iron cannot be removed by chemical treatment, and the bug still must be reckoned with.

● **Injection well.** *Completion.* The well is either drilled new outright or an old oil well may be converted into one. So far as the injection formation itself is concerned, the completion of the well is the same whether for open or closed system.

Tubing and casing. For a closed type system, where corrosion is of no concern or consequence, regular steel casing or plain steel tubing may be used in the well. As water may be flowed through both tubing and casing, even where a subsurface control valve is used, the problem of flow restriction due to size of pipe is greatly minimized.

The Erwin sub-surface control valve. Object. This subsurface control valve is placed in the vicinity of the shut-in static level of the injection well for the purpose of maintaining a full column of water to the top of the well at all times. This valve is applicable, mainly, in wells that can take more water than that currently supplied to them.

Function and advantages of valve in well. Prevents gas locking of well by eliminating necessity of keeping gas blanket on well itself; prevents vacuum on wellhead thus insuring against air leaks into system and breakdown of bicarbonates due to vacuum; is wholesome for well absorption zone in that brine is introduced at zone's maximum capacity at intervals rather than trickle in possibly in small amounts continuously; enables operator to know exact capacity of well at all times and gives valuable index as to whether well is plugging, improving, etc.

Nature of valve and its control. Any suitable single seated valve arrangement may be used, such as a seating nippled in string of tubing with packer. The valve plunger may be actuated by hydraulic piston or by a wire line. The level in the surge tank at the surface actuates the valve, opening it when the tank is full and closing it when the tank is nearly empty. Such a valve and control arrangement is available on the market. This valve control method is covered by a basic patent.

● **Chemistry of closed system (brief).** The three chief offenders, iron, calcium, and magnesium usually occur as chlorides and bicarbonates in the brine in the lowest valency. All three may be precipitated upon breakdown of the bicarbonate radical due to heating, aeration, or subjection to vacuum. The calcuim and magnesium precipitate as carbonates, the iron as ferrous hydroxide (in absence of oxygen) and as ferric hydroxide in presence of oxygen. In all cases carbon dioxide chemically breaks out of the system, HCO_3 yields (plus heat, vacuum or O_2) CO_2 plus $-OH$. The hydroxyl then reacts with calcium, magnesium and iron to form the compounds mentioned. When sulphate reducing bacteria are present, it works on the sulphate radical to form hydrogen sulphide, among other products, which immediately reacts with ferrous iron to form black, highly insoluble, ferrous sulphide that plugs the well. This bacteria also builds or is composed of a gelatinous organic cellular material that is not readily soluble in any of the acids, even hot sulphuric. This renders most difficult the unplugging of a well plugged with material by chemical or acid means.

★★★

(This is the final installment of the class proceedings on Salt Water Disposal in East Texas.)

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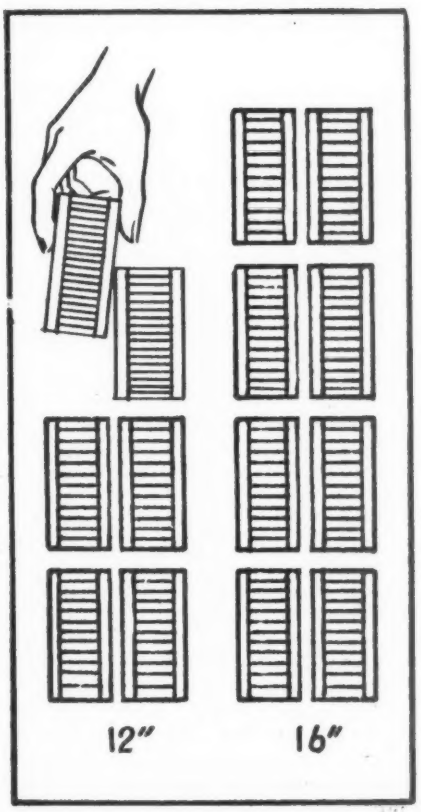
(1) *Unitized slips*

Baash-Ross "DU" unitized slips are designed so that the same body will fit a wide range of pipe sizes by simply changing the liners. This eliminates need for carrying a separate body to fit each size of pipe used on a drilling rig, greatly simplifying changeover operations and minimizing inventory needs.

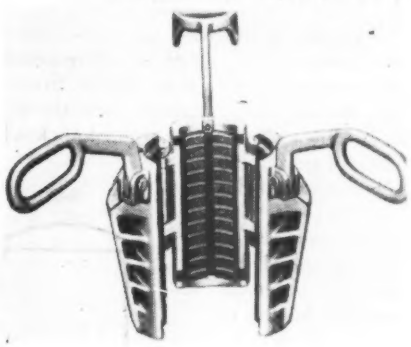
The slips now incorporate still another advancement that both simplifies inventory requirements and permits longer liner life to be obtained, according to the manufacturer. Instead of the liners being made in full length sizes to fit 12-in. and 16-in. bodies in which Baash-Ross slips are available, the liners are now made in short 4-in. segments that are locked into the bodies the same as the longer lengths and give the same rigid grip. With these new 4-in. slips it is no longer necessary for an operator to stock supplies of both 12-in. and 16-in. liners, it is stated. By having a supply of 4-in. liners the operator can use three of these segments to make up a 12-in. liner, and four to make up a 16-in. liner.

Showing how liner segments are arranged to make 12-in. and 16-in. length liners.



Besides greatly simplifying inventory requirements, this new advancement also lengthens the life of the slips by making it possible to change only the worn sections while re-using for further service any slip segments that are only partially worn. When the master bushing is out of line or the pipe hangs against one side of the hole, the bottom part of the liner will often show greater wear than the top part. With the new short Baash-Ross liner segments, it is only necessary to replace those segments that are worn and leave the unworn segments in the body for further service. This, of course, reduces liner replacement costs to a minimum.

Showing how liner segments make complete full length liners when installed.



Baash-Ross Tool Company, 5512 Boyle Avenue, Los Angeles 11, California, is the manufacturer.

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(2) *Running-time recorder*

A new instrument for recording machine running-time has been developed by The Bristol Company, Waterbury, Connecticut, for checking machine performance. The instrument records the operating or "on" time of production machinery and other similar equipment. The chart record gives the total "on" time in hours, minutes, and seconds for a given period. "Off" periods are also shown on the chart as well as the time at which they occurred.

The running-time readings are magnified in such a way that the total operating time of a machine can be easily and accurately determined to within a few seconds.

(3) *Scott air pack*

The Scott Aviation Corporation, Lancaster, New York, announces the introduction of a new type of breathing apparatus that is said to broaden considerably the scope of safety equipment in oil refineries and sour crude oil fields.

Called the Scott Air-Pak, it literally had its inception in the battleskies. Throughout the war and for our principal Allies, Scott has manufactured demand-type regulators for use with portable oxygen equipment in high altitude flying. This equipment, popularly known as the "walk-around bottle" permitted flying personnel to leave their stations in military aircraft and take up other duties in different parts of the airplane. During high altitude missions this would not have been possible otherwise, for without the "walk-around bottle" men were compelled to stay at their stations and utilize the permanent oxygen installation available for them.

About two years ago, Scott recognized the vast field that existed in fire fighting and general industrial use for a type of breathing apparatus utilizing normal breathing air—not oxygen—that could be stored under pressure in a compressed air cylinder, with the result that pure breathing air was carried to the hazards and not drawn and refined there.

Also, the Scott Air-Pak is ready for instant use. There is no long preparation or period of training, no chemicals required. All that is necessary is to don the apparatus and enter the area of hazard. The Scott Air-Pak, according to company officials, offers other advantages such as its "Quick-Connect," which permits the wearer to breathe through the open end of the low pressure face mask hose until entering the danger zone, thus conserving the air supply for actual use under working conditions.

The Scott Air-Pak utilizes the well-known Willson mask. The mask includes among its features shatterproof lenses cushioned in rubbers designed to allow full unobstructed vision in all directions. The fresh, cool, breathing air drawn into the mask eliminates all lens fogging and the completely efficient exhalation valve prevents the accumulation of dangerous gases inside the mask, it is stated.

The demand-type regulator is for all intents and purposes the same as that employed by the Army and tested through hundreds of thousands of hours under extreme service conditions. Integral with the demand-type regulator is a

pressure gage showing the exact amount of air remaining in the compressed air cylinder at all times. This gage is provided with luminous figures and can be seen readily under all normal working conditions.

The harness of the Scott Air-Pak is made of neotexed cotton webbing 2½ in. wide and equipped with snap hooks and self-locking slide buckles.

There are two types of compressed air cylinders utilized in the Scott Air-Pak:

1. The back pack model can be installed in three or four minutes on the comfortable contoured aluminum backplate. This can even be done on the back of the wearer for the interchange of cylinders in less than three minutes. The compressed air cylinder has an integral pressure valve that indicates the exact pressure remaining in the cylinder and prevents using a cylinder from which the air has already been drawn.

2. The sling type Scott Air-Pak includes all features of the back pack model but is preferred for chemical laboratory work and for instant use in all areas where breathing hazards exist. Special wall cases for permanent installation are available for these applications.

It is interesting to note that the equipment can be used to great advantage not only for fire fighting and general emergency use where breathing hazards exist or are discovered, but also in the cleaning of tank cars, fuel tanks, in granaries, mines, and in the marine fields for cleaning tankers, barges, and all hulls and holds.

In these latter applications it offers a feature the value of which is readily apparent to all those engaged in these industries. It is not necessary for a man to carry an air line into the area with the attendant possibilities of fouling and the restriction of free movement.

The Scott Air-Pak is self-contained and complete and workers in these industrial endeavors are supplied fresh, cool breathing air that is also invigorating, adding to their general efficiency.

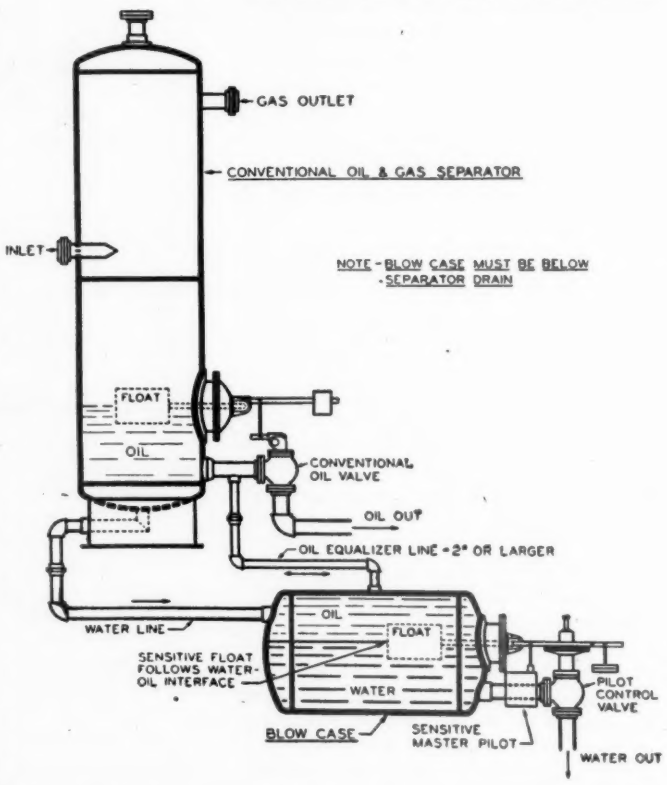
(4) *Water knockout*

With the application of a new, sensitive master pilot recently developed with pilot-controlled oil valves, Black, Sivalls and Bryson have created a new use for their blow case as a free water knockout, officials announce.

Large quantities of free water in production should be eliminated before this water enters the heater or stock tank, it is asserted. A blow case with a sensitive master pilot controlling the outlet valve can be used with a separator to perform this function. (See illustration.)

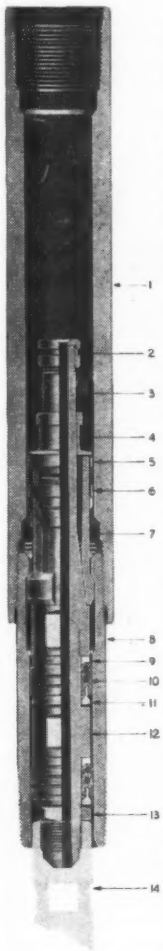
When free water separates from the oil in the separator it proceeds to the blow case through the conventional separator drain, according to the manufacturer. A sensitive float follows this interface. When the interface rises, the pilot-operated valve in the blow case outlet line opens and dumps part of the salt water in the blow case. When the oil-water interface drops to a predetermined level, this valve in the outlet line closes until the water in the blow case builds up again, BS&B explains.

According to BS&B officials, certain limitations are apparent in this hookup. The specific gravity of the oil must be enough different from that of the water that a fairly sensitive float will follow the interface. The new, sensitive master pilot must be used to control the pilot control oil valve on the blow case outlet line.



(5 *Landing nipple*

A definitely located standard foundation for use of subsurface controls in flowing wells is now offered by Otis Pressure Control, Inc., Dallas, Texas.



Installation of the new Otis Type J landing nipple (8) as standard equipment when a well is tubed makes provisions for the simple and easy execution of several important operations that otherwise would be difficult, if not impossible, it is stated.

The J nipple provides a definitely located seat for use of the Type J removable pack-off and locking assembly that, in turn, makes the installation of other subsurface tools simple and practical regardless of the temperatures, pressures, and depths encountered.

The Otis Type J flow coupling (1) is an integral component of the Type J landing nipple. The extra thick walls of this longer and more sturdy flow coupling afford prolonged wear against abrasive action caused by possible turbulent flow action immediately above the actual control device, the manufacturer asserts.

The shoulder of the J nipple itself provides a metal-to-metal contact, supplanting slip teeth and friction holds. Reduction in the tubing bore, at the J nipple, of only 10½ per cent for a few inches, does not appreciably reduce the flow capacity of the tubing. Bottom hole pressure bombs, samplers, inside cutters, etc., can still be run.

The new Otis Type J removable pack-off and locking assembly, seated in the Type J landing nipple, is a positively locked and perfectly sealed device built to facilitate successful operation of other Otis pressure controls under 10,000 lb. per sq. in. and 350° F. temperature. The slight restriction, mentioned above in discussing the nipple, makes possible the use of a new asbestos-base heat-resistant packing. The packing fits so snugly in the landing nipple that it is not necessary to flow the well to set the packing. This is particularly important when there is danger of pulling sand or water into the tubing string.

These three tools, the Type J flow coupling and the Type J landing nipple included as standard equipment in the tubing string of flowing wells, plus the Type J removable pack-off and locking assembly, offer field engineers and operators a solution to expected, and unexpected, subsurface problems, according to Otis Pressure Control, Inc.

In the accompanying illustration, numbers designate the following:

1. Flow coupling.
2. Retaining nut.
3. Lock mandrel.
4. Slip carrier.
5. Slip carrier band.
6. Mandrel band.
7. Slips.
8. Landing nipple.
9. Male packing adapter ring.
10. Packing.
11. Female packing adapter ring.
12. Packing mandrel.
13. Packing mandrel nut.
14. Subsurface control.

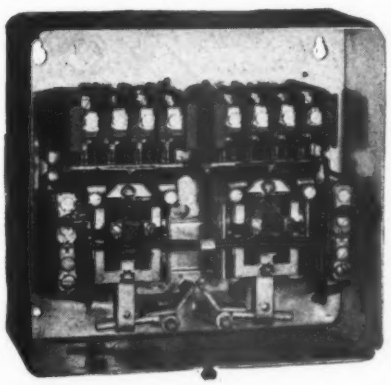
---

(6) *G-E starter*

A new a-c, magnetic reversing starter, featuring a semi-interference-type mechanical interlock, has been announced by the Industrial Control Division of the General Electric Company. Available in sizes 0 and 1, the new starter is designed for full voltage starting of squirrel-cage induction motors, although it can easily be used for reversing service when combined with a reduced voltage starter.

Easy to adjust, the new semi-interference-type mechanical interlock prevents the closing of one contactor while an arc is maintained on the other, thus averting a short circuit through the arc and the resultant burned contacts and blown fuses. In addition, the interlock arm of the closing contactor assists the interlock arm of the opening contactor in reaching its fully opened position. These interlock arms are case-hardened and their underside faces are buffed and polished to provide long life.

Other features incorporated in this starter are undervoltage protection when used with a push-button station or other momentary pilot-circuit device; undervoltage release when used with selector or limit switches; and tamperproof, self-contained overload relays that allow the motor to operate up to its maximum safe temperature before tripping it off the line. The starter is housed in a sturdy metal enclosure 9⅞ by 13⅝ by 4 9/16 in size, equipped with a hook-on cover and finished with smoothly rounded corners. Dusttight and watertight enclosures are supplied where special conditions warrant.



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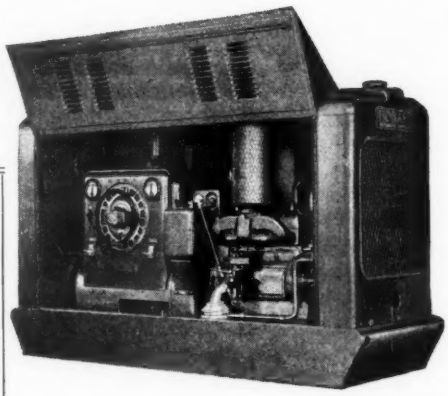
(7) *Engine-driven welder*

The light weight but husky, full capacity 200-amp. "simplified" engine-driven arc-welder shown in the accompanying illustration is the first postwar model to be announced by The Hobart Brothers Company, Troy, Ohio. Completely enclosed in a compact steel canopy with hinged side panels and powered with a sturdy 26-hp. 4-cylinder engine for economical operation, this new unit has a wide range of 40 to 275 amp.

Multi-range dual control of welding current makes it easy for the operator to adjust voltage and amperage relationship to the fine degrees that are required of present and future welding amplifications or for use with all present and forthcoming electrodes, the manufacturer asserts. The multi-range dual control wheel on the front of the generator control panel corresponds to the station selector of a modern radio receiver and the volt-ampere adjuster situated inside the wheel corresponds to the radio volume control. With 10 ranges of welding current and 100 steps of volt-ampere adjustment in each range, the Hobart multi-range dual control makes available 1000 combinations of open circuit voltage and welding current for selecting any desired arc characteristics.

Remote control, a standard equipment feature of all Hobart welders, allows the volt-ampere adjuster to be easily removed from the control panel for use with an ordinary extension cord so that the operator can adjust the welding heat right at the work, eliminating repeated trips between the welding work and machine.

Standard equipment also includes the



mercury type idling device that automatically idles the engine when not in use, reducing fuel consumption and engine wear.

The illustration shows the stationary model with newly designed steel skid mounting, beveled at both ends with tubular end cross members for easy skidding. Portable mountings on a 2-wheel pneumatic tired trailer or on 16-in. shop type wheels are also available.

(8) *"Low-swing" strainer*

A new strainer has been announced by J. B. Trotman, general sales manager of the Blackmer Pump Company, Grand Rapids, Michigan. Developed as a wartime protective and conservation measure for critical pumping equipment, the new Low-Swing strainer has been added to the company's line of Ezy-Kleen strainers and is now available for reasonably prompt delivery.

The following features are pointed out for the new strainer by the manufacturers:

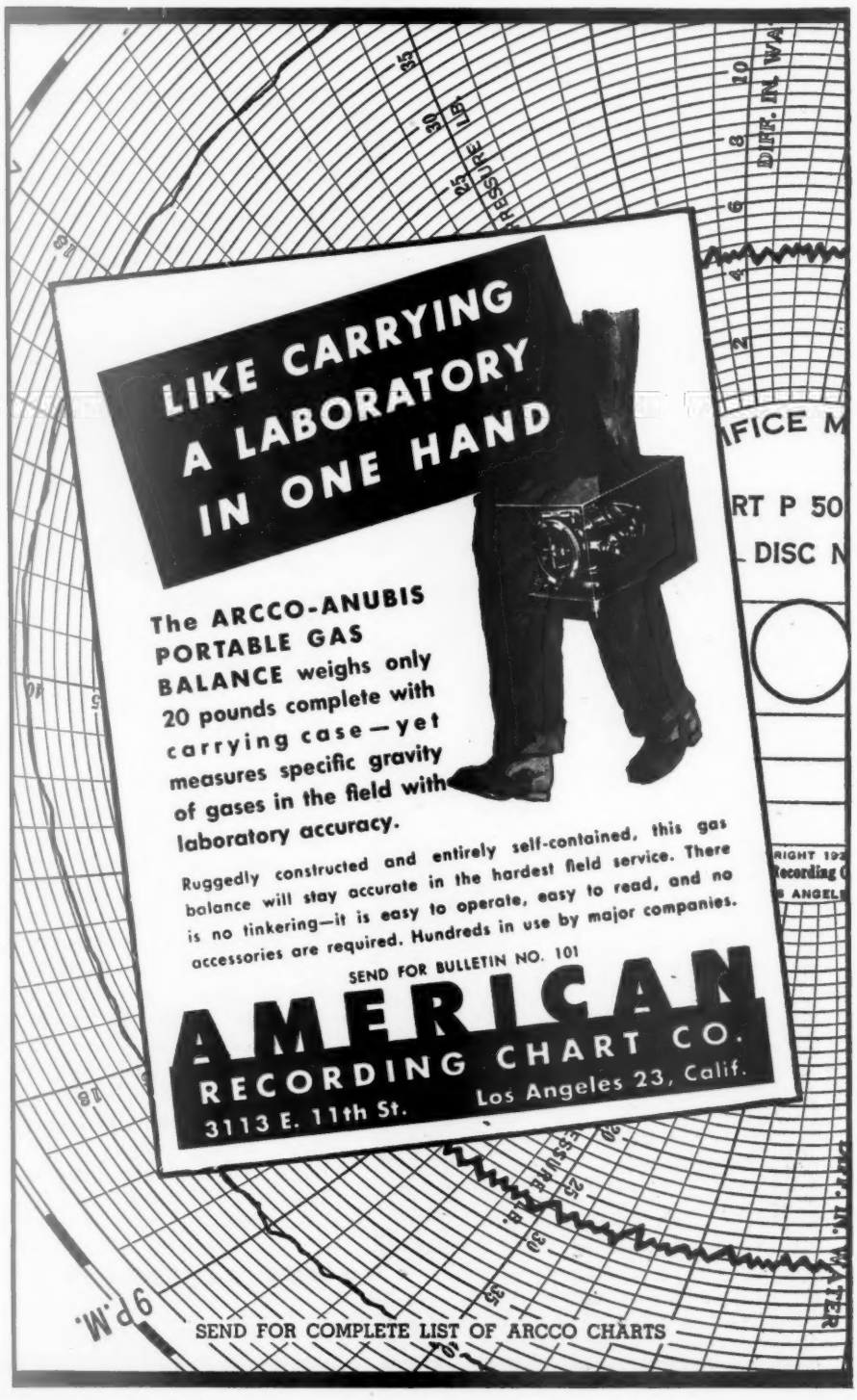
1. Use of perforated metal, steel or bronze, instead of wire screen for the strainer basket makes the basket less liable to damage in cleaning and gives it longer life.

2. Slotted lugs of the top plate line up with the lugs of the strainer body to receive the four holding bolts. This permits quick removal of basket for cleaning.

3. Compact design permits mounting in small space or in lines along walls.

4. Strainer is designed for flange mounting. Companion flanges are included as a part of the unit.

Present production is limited to a capacity of 100 GPM with 2-in., 2½-in., and 3-in., intake and discharge sizes. Maximum operating temperature is 600° F. Maximum pressure is 75 lb. per sq. in. Larger and smaller sizes eventually will be added to the line, it is said.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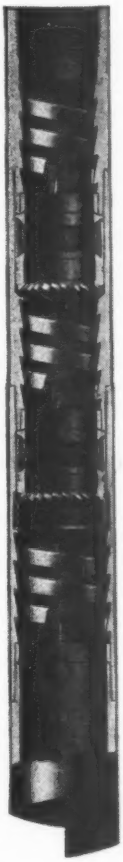
(9) *Bowen overshot*

Increased use of externally upset drill pipe has made it essential that a tool be developed for catching strings of this type. The Series 350 Bowen Overshot is a tool that the makers say will catch and pack off pipe, pipe upset or tool joint without making any changes or adjustments. It is a three-bowl assembly, incorporating grapples and pack-off rubbers for the three sizes, milling members for rounding up the jagged ends of pipe or upset, and a guide for centering the fish in the tool. The manner of assembling the grapples in the tool provides the small outside diameter that enables this tool to be used under unusually tight hole conditions without sacrificing overall strength, it is stated. For example, one popular Series 350 Overshot has an outside diameter of only 5¾-in. and catches and packs off 3½-in. drill pipe, 3 13/16 in. O.D. external upset, and 4¾-in. O.D. tool joints.



Another has an outside diameter of 7⅝ in. and catches and packs off 4½ in. drill pipe, 5-in. O.D. external upset, and 6⅛-in. O. D. tool joints.

An important feature of the Series 350 is that it both sets and releases on right-hand rotation, thus avoiding the dangers of turning the string in an unscrewing direction. Right-hand rotation of the string expands the grapple as the tool is simultaneously lowered over the fish, and simply allowing rotation to stop causes the grapple to take hold around the fish. Thereafter when upward pull is exerted the hold is secure, for the Bowen Overshot takes hold as soon as it is over the fish. Release is easily effected by simply first bumping down to break the hold and then turning the run-in string to the right to again expand the grapple and, at the same time, slowly raising the string until the overshot is clear.

The Series 350 Bowen Overshot is available in a complete range of sizes in both right and left-hand assemblies, and with undersize grapples and rubbers to catch and pack off worn tool joints or drill collars. S. R. Bowen Company, Huntington Beach, California, is the manufacturer.

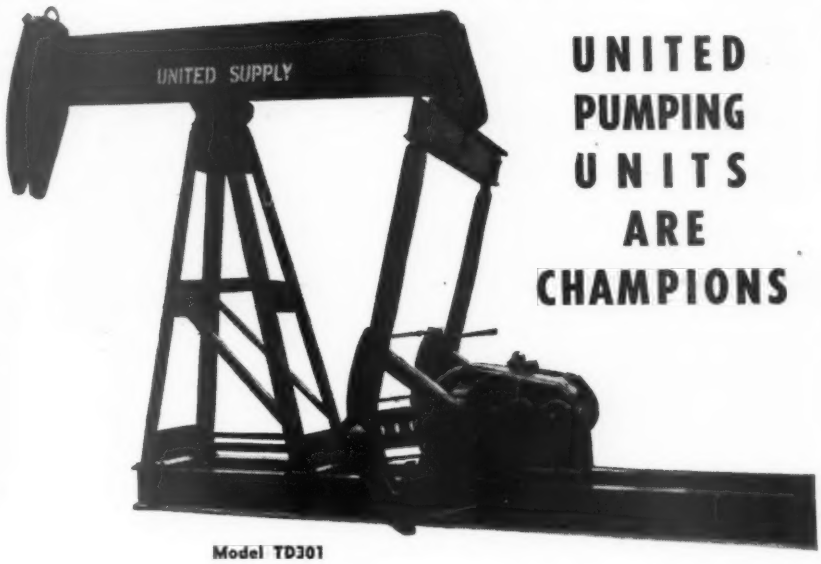
(10) *Silicone varnish*

DC 996 Silicone varnish, a new heat stable, waterproof varnish for impregnating electrical equipment, is announced by Dow Corning Corporation, Midland, Michigan.

Because of its low curing temperature this new Silicone varnish enables all types of electrical shops to realize the advantages of Silicone insulation, the manufacturer states. Among these advantages are greater protection against failure due to sustained overloads, greatly increased service life of electrical insulation, higher permissible operating and ambient temperatures, increased protection against excessive moisture even after prolonged exposure to elevated temperatures, the elimination of fire hazards resulting from the failure of conventional electrical insulation, and increased power output per unit weight, it is asserted.

Electrical equipment wound with Silicone insulating materials and sealed by impregnating with DC 996 will have the high order of thermal stability and retention of waterproofness characteristic of Silicone insulation, it is said. Silicone insulating materials impregnated and bonded with DC 993 are available through leading distributors of electrical insulations. DC 996 can be cured at temperatures obtainable in ovens now used for curing organic varnishes.

Another feature of this new Silicone varnish is that electrical equipment can be baked fully assembled without damaging the commutators or the slip rings. The temperature required to cure DC 996 does not affect shellac-bonded mica or core plating.



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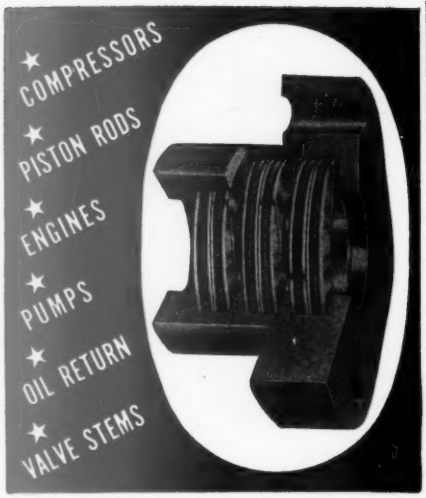

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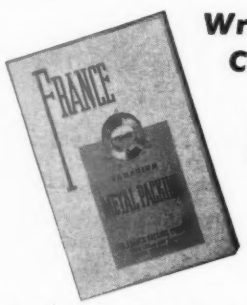

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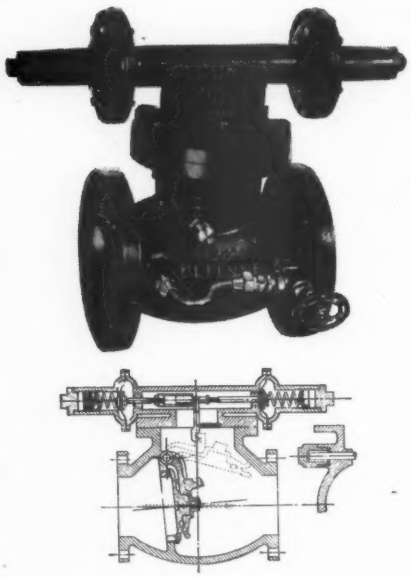
(11) *Shut-off valve*

Security Valve Company, 410 San Fernando Road, Los Angeles 53, California, announces the "Defense" automatic shut-off valve for gases, oils, and other liquids. The valve is designed for installation in industrial plants as a protective measure against fire, damage and losses that may occur when lines are ruptured, flash-backs occur or pressures become unsafe.

The valve is positive, instantaneous, and accurate in its operation and can be relied upon to close automatically gas or oil lines in the event of their rupture by explosion, earthquake shock, flood, sabotage or accident; or when the pipe line pressure rises above or falls below safe predetermined maximum and minimum pressures, the manufacturer states.



The valve is not subject to premature closing due to vibrations.

Valves placed in reverse to each other, on either side of a danger area to a pipe line, will in case of a rupture, save both flow and line pack. When operating, pipe line pressures rise above or fall below the closing pressures set on the diaphragm springs, the diaphragm shafts move the disk lever, trips the latch, releases the valve disk, and allows the valve to close. To reset the valve the screwed cap cover on the stuffingbox is removed and the valve disk lever rotated until the dog on the lower end of the tripping latch engages the dog on the valve disk.

Valves are available in eight sizes, from 1¼-in. to 8-in. The 1¼-in. and 1½-in. sizes are screw type and those of 2-in. and over are flanged.

(12) *Welding electrode*

A new combination type welding electrode, Airco No. 315, designed to produce horizontal fillet welds with flat or slightly concave profiles and concave fillets in the flat position, as well as satisfactory deep fillet and deep groove, has been announced by Air Reduction Sales Company.

Usual application for the new electrode include pressure vessels and their connections, heavy machine weldments, structural assemblies such as trusses, built-up girders and connections, and practically all heavy steel assemblies where high weld quality is important.

Airco No. 315 electrode is recognizable by its steady, forceful spray type arc, it is stated. The thick porous slag, which completely covers the weld deposit under practically every condition, is readily removed. The electrode may be used with conventional technique, employing normal currents, under which conditions medium penetration is obtained. Deeper penetration is obtained, however, when the deep fillet technique is used with the high currents recommended for this procedure. The new Airco No. 315 can be used for any job that calls for a 6020 or 6030 electrode and may be applied with either the alternating or direct current, straight or reverse polarity.

(13) *Vertical motor*

The Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, New Jersey, announces a new addition to the company's line of protected-type a-c. motors. The newcomer, a vertical drip-proof motor that is rated at 40 C. rise continuous duty with a 15 per cent service factor, is designed for operation from 60 or 50 cycle, 3 or 2-phase circuits at all standard voltages. At present a NEMA "B" flange type mounting up to and including the "284" frame,

and a NEMA "C" face type mounting up to and including the "326" frame is available.

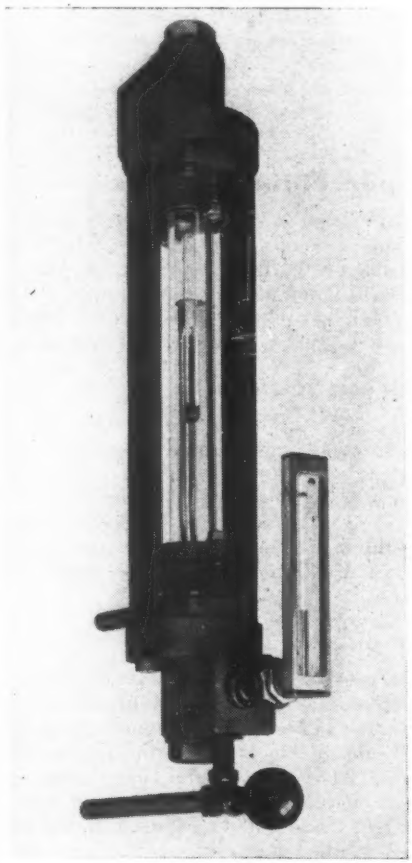
All ventilating openings of this new line of motors are shielded against the entrance of dripping liquids and falling particles. Oversize ball bearings are provided to carry thrust in addition to the rotor, and the use of the company's patented centrifugal bearing seal permits the use of softer grease for better lubrication and longer bearing life, the manufacturer states.

A new recessed junction box, which provides ample room for making electrical connections, is employed in the motor's design. The Crocker-Wheeler Alucast rotor, with bars, fans, and end rings cast in one operation from aluminum alloys, is used. Other features include: Heavy cast frame construction and coils protected with Vinylastic insulation.

(14) *Gravity indicator*

A new specific gravity indicator has been announced by the Schutte and Koerting Company of Philadelphia, Pennsylvania, after thorough installation trials. By permitting continuous indication of a flowing sample, the time-lagging, often troublesome, intermittent sampling method is eliminated, it is stated.

Flow to the SK specific gravity indicator is regulated by a valve. Liquid rises in the heavy-walled glass tube to a height determined by outlet pipes, overflows and is returned to the process. Specific gravity is indicated on a standard hydrometer within the tube. An integrally mounted thermometer provides for convenient temperature measurement when hydrometer is read.



An adaptation of the SK Universal rotameter, the indicator is readily installed in new or existing pipe lines.

(15) *Measurement, control*

Utilizing the principle that the electrical characteristics of a wire filament change with a physical strain, the Baldwin Locomotive Works' Southwark Division has developed a pressure sensitive device that promises to open whole new fields of measurement and control.

The new instrument, called the SR-4 Pressure Sensitive Device, is used to convert gas or liquid pressure to electrical energy for measuring, recording, or controlling. Its extreme accuracy, one-fourth of one per cent of full scale having been consistently obtained, will mean that the device can be used for control operations that heretofore have not been possible, it is stated. It is available in several ranges up to 0-to-20,000 lb. per sq. in.

As it is essentially an electronic device, it will enable results to be transmitted long distances whether for direct reading, recording, or control. Transmission even by radio is feasible. This will eliminate the leakage and clogging troubles, the manufacturer asserts.

The SR-4 Pressure Sensitive Device is, as its name implies, based on the principle of the SR-4 strain gage.

The heart of the device is a very fine filament wire bonded to a hollow metal core against which is exerted the gas or liquid pressure to be measured. As the pressure increases this filament stretches, thus changing the diameter of the wire and causing measurable changes in the electrical resistance of the wire. This change in resistance varies the amount of current flowing through the filament circuit and, when amplified, these changes show up on the dial or are used to actuate a control system. The filament is sensitive to a "stretch" of the metal core of only one-millionth of an inch. It is this ability to measure great changes in pressure without any physical movement that has led to a description of the instrument as being actuated by the "breathing" condition of the metal.

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with MARTIN PLUNGERS

Greater ring life is obtained with the patented one-piece body construction and uniform ring size obtained by the Martin method of compensation for thickness variations.

The uniformity of the ring fit insures less wear on pump tubes and better all-around performance than is possible with any other type of ring plunger.

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MRS. LYNN HOLLOWAY, Houston, Texas
J. WALTER WADE, Chicago, Illinois
E. C. DILGARDE, Casper, Wyoming

TRADE LITERATURE

Publications listed are sent free upon request.

(16) *Chemical scale removal*

Dowell Incorporated, Tulsa, Oklahoma, has issued a booklet, "More Power to America's Industry", that describes the company's chemical scale removal service. This service is in use by the petroleum industry, especially the refining division.

(17) *Rotary casing scraper*

The Baker rotary casing scraper is discussed in a bulletin published by Baker Oil Tools, Inc., Los Angeles, California. The casing scraper, it is pointed out in the bulletin, restores the original inside diameter of the casing so long as the roundness of the pipe itself has not been distorted.

(18) *Self-priming pump*

Bulletin No. 51 of the LaBour Company, Inc., Elkhart, Indiana, discusses and illustrates a new feature of its self-priming centrifugal pump. The Type G pump is designed to require no packing or mechanical seal. The new pump is said to be an efficient, vertical, self-priming unit retaining and improving on all good features of the older LaBour pumps.

(19) *Pesco hydraulic pumps*

The Pesco "pressure-loaded" feature, originally engineered into aircraft pumps for the express purpose of making flight operations possible through a wide range of temperature and altitude conditions, is incorporated in the design of Pesco hydraulic pumps for industrial applications, it is announced by Pesco Products Company, Cleveland, Ohio. The efficiency of gear type is determined largely by the end clearance between the gears and the casing of the pump, it is pointed out. To handle high pressures efficiently, this clearance must be kept at a minimum. "Pressure-loading" accomplishes this by automatically taking up wear that otherwise would increase the clearance, the manufacturer asserts.

(20) *X-ray diffraction*

A new 16-page illustrated booklet that covers basic theory, principles and applications of X-ray diffraction has been announced by North American Philips Company, Inc., 100 East 42nd Street, New York. Text material was written by F. G. Firth, research engineer, and is divided into three sections. Part 1 deals with the basic principles and theory of X-ray diffraction. Part 2 discusses the constitution of matter. Part 3 treats many application problems at considerable length.

In detail, the booklet explains: 1. How X-rays are diffracted. 2. Technique of powder identification. 3. How various types of film-type equipment work. 4. Advantages of the new Geiger-counter X-ray Spectrometer. 5. Low-angle scattering. 6. Particle size and orientation of matter. 7. Alloy formation. 8. Organic compounds. 9. Catalysts. 10. Studies of mineral substances. 11. High polymer work. 12. Petroleum products, and 13. Heat exchanger problems.

(21) *Unaflo oil well tables*

Slurry formulas, pipe data and tables on down-the-well quantities of cement and drill mud are provided in a new 16-page pocket-size booklet, "Unaflo Oil-Well Tables," issued by Universal Atlas Cement Company, United States Steel Corporation subsidiary. The booklet shows pipe sizes, useful equivalents, hydrostatic pressures of various fluids, and cement slurry and drill mud formulas and tables for capacity, annular space and displacement for the commonly used sizes and weights of drill pipe, tubing and casing included in the API Simplified List. A unique feature of the tables is that they show the different quantities of cement required for different weights of cement slurry.

(22) *Airco welding accessories*

An up-to-date price list and catalog of Airco gas welding and cutting supplies and accessories has been published by Air Reduction, 60 East 42nd Street, New York 17, New York. This 16-page booklet contains illustrations, descriptions, engineering data, and current prices. Types of equipment covered include welding rods, brazing and welding flux, hose, brazing alloys, goggles and spectacles, gloves for gas welding and cutting, and sparklighters and tips. Also listed are carbon rods and plates, hardfacing rods, cobalt borium inserts, pea borium, and other items.

(23) *Safety control system*

Data sheet R-18, just released by Viking Instruments, Inc., Stamford, Connecticut, announces the Viking Type R-18 Safety control system for the shut down of diesel engines when temperature of the circulating water system becomes too high, or when there is insufficient lubricating oil pressure. The data sheet contains complete information on operation, with detail drawings of general arrangements, installation and operating instructions, and ordering information. The Type R-18 control system is self-operating and requires no electrical power or additional accessories.

(24) *"Kosmos" porcelain plungers*

A 6-page illustrated data sheet, No. 57-2, completely describing "KOSMOS" porcelain plungers, which can be used on almost any hydraulic pump up to 2000 lb. per sq. in., is now available from the Aldrich Pump Company, Allentown, Pennsylvania. The data sheet gives complete construction details, specifications, types of service, and purchasing information.

(25) *Valve lubricant manual*

Featuring the uses of lubricants in lubricated plug valves, Merco Nordstrom Valve Company has released a new and completely reedited. manual. It gives complete instructions in application of valve lubricants and lists 40 types in stick and bulk form including a silicone type. More than 100 specific valve services are included, with corresponding lubricant recommendations, for various conditions of line fluid, temperature, and pressure.

(26) *Instrument panels*

Bulletin No. 44-2, released by Jones Motrola Corporation, Fairfield Avenue, Stamford, Connecticut, manufacturers of tachometers and other marine and industrial products, describes four models of Jones Instrument Panels for marine application. This bulletin illustrates models for single and twin engine operation, with instruments in black crinkle finish, and brass, nickel or chrome finish panel, unlighted or indirectly lighted. Panels include tachometer, ammeter, oil pressure gage and heat indicator—one or two of each instrument, depending on the model. Bulletin 44-2 also gives specifications for individual mount tachometers, together with prices and complete ordering information.

(27) *Chain Belt products*

A new bulletin on Rex and Baldwin-Rex oil field products has been released by the Chain Belt Company of Milwaukee, Wisconsin. Its 12 pages contain descriptive matter, specifications, prices and photos. Price lists, strengths and dimensions are given. One section of the booklet is devoted to tips on the care of chain, and another on the line of Rex oil field pumps.

(28) *Portable hydraulic press*

The Rodgers portable hydraulic press is completely described in a new catalog released by Rodgers Hydraulic, Inc., Minneapolis, Minnesota. Specifications, capacities, and other informative details are given. Also shown are illustrations of the versatility of the press made possible through its simple, unique design and adaptability to most any heavy duty pulling or pressing problem, such as gears, pinions, bushings, etc. Other Rodgers equipment described in the catalog includes shop presses, hooks and lugs for pulling, jacks, hydrostatic test units, power-operated hydraulic pump units, pipe-straightening equipment.

WEIGHT INDICATOR CONVERSION TABLES

TABLE 2. Conversion table for gage readings on weight indicator with 1⅛-in. cable—*Continued.*

Gage reading points	Number of lines							Gage reading points	Number of lines						
	1	2	4	6	8	10	12		1	2	4	6	8	10	12
45	14800	29600	59200	88800	118400	148000	177600	75	30200	60400	120800	181200	241600	302000	362400
46	15240	30480	60960	91440	121920	152400	182880	76	30800	61600	123200	184800	246400	308000	369600
47	15690	31380	62760	94140	125520	156900	188280	77	31400	62800	125600	188400	251200	314000	376800
48	16140	32280	64560	96840	129120	161400	193680	78	32000	64000	128000	192000	256000	320000	384000
49	16590	33180	66360	99540	132720	165900	199080	79	32610	65220	130440	195660	260880	326100	391320
50	17050	34100	68200	102300	136400	170500	204600	80	33220	66440	132880	199320	265760	332200	398640
51	17515	35030	70060	105090	140120	175150	210180	81	33830	67660	135320	202980	270640	338300	405960
52	17985	35970	71940	107910	143880	179850	215820	82	34440	68880	137760	206640	275520	344400	413280
53	18460	36920	73840	110760	147680	184600	221520	83	35050	70100	140200	210300	280400	350500	420600
54	18940	37880	75760	113640	151520	189400	227280	84	35675	71350	142700	214050	285400	356750	428100
55	19425	38850	77700	116550	155400	194250	233100	85	36300	72600	145200	217800	290400	363000	435600
56	19915	39830	79660	119490	159320	199150	238980	86	36925	73850	147700	221550	295400	369250	443100
57	20410	40820	81640	122460	163280	204100	244920	87	37550	75100	150200	225300	300400	375500	450600
58	20910	41820	83640	125460	167280	209100	250920	88	38190	76380	152760	229140	305520	381900	458280
59	21410	42820	85640	128460	171280	214100	256920	89	38830	77660	155320	232980	310640	388300	465960
60	21920	43840	87680	131520	175360	219200	263040	90	39470	78940	157880	236820	315760	394700	473640
61	22430	44860	89720	134580	179440	224300	269160	91	40110	80220	160440	240660	320880	401100	481320
62	22945	45890	91780	137670	183560	229450	275340	92	40750	81500	163000	244500	326000	407500	489000
63	23460	46920	93840	140760	187680	234600	281520	93	41395	82790	165580	248370	331160	413950	496740
64	23980	47960	95920	143880	191840	239800	287760	94	42040	84080	168160	252240	336320	420400	504480
65	24500	49000	98000	147000	196000	245000	294000	95	42685	85370	170740	256110	341480	426850	512220
66	25025	50050	100100	150150	200200	250250	300300	96	43330	86660	173320	259980	346640	433300	519960
67	25550	51100	102200	153300	204400	255500	306600	97	43975	87950	175900	263850	351800	439750	527700
68	26100	52200	104400	156600	208800	261000	313200	98	44620	89240	178480	267720	356960	446200	535440
69	26650	53300	106600	159900	213200	266500	319800	99	45265	90530	181060	271590	362120	452650	543180
70	27225	54450	108900	163350	217800	272250	326700	100	45910	91820	183640	275460	367280	459100	550920
71	27800	55600	111201	166800	222400	278000	333600								
72	28400	56800	113600	170400	227200	284000	340800								
73	29000	58000	116000	174000	232000	290000	348000								
74	29600	59200	118400	177600	236800	296000	355200								

Average value of one indicator point in pounds for obtaining bit pressure in pounds—1⅛-in. drilling line.

Between gage readings below	Number of lines							Between gage readings below	Number of lines						
	1	2	4	6	8	10	12		1	2	4	6	8	10	12
5–10	309	618	1236	1854	2472	3090	3708	50–60	487	974	1948	2922	3896	4870	5844
10–20	328	656	1312	1968	2624	3280	3936	60–70	531	1062	2124	3186	4248	5310	6372
20–30	347	694	1388	2082	2776	3470	4164	70–80	600	1200	2400	3600	4800	6000	7200
30–40	393	786	1572	2358	3144	3930	4712	80–90	625	1250	2500	3750	5000	6250	7500
40–50	438	876	1752	2628	3504	4380	5256	90–100	644	1288	2576	3864	5152	6440	7728

TABLE 3. Conversion table for gage readings on weight indicator with 1¼-in. cable.
Refer to Sheet 1 for adjustment procedure.

Gage reading points	Number of lines							Gage reading points	Number of lines						
	1	2	4	6	8	10	12		1	2	4	6	8	10	12
5	200	400	800	1200	1600	2000	2400	15	3150	6300	12600	18900	25200	31500	37800
6	490	980	1960	2940	3920	4900	5880	16	3470	6940	13880	20820	27760	34700	41640
7	780	1560	3120	4680	6240	7800	9360	17	3790	7580	15160	22740	30320	37900	45480
8	1070	2140	4280	6420	8560	10700	12840	18	4110	8220	16440	24660	32880	41100	49320
9	1360	2720	5440	8160	10880	13600	16320	19	4430	8860	17720	26580	35440	44300	53160
10	1650	3300	6600	9900	13200	16500	19800	20	4750	9500	19000	28500	38000	47500	57000
11	1950	3900	7800	11700	15600	19500	23400	21	5090	10180	20360	30540	40720	50900	61080
12	2250	4500	9000	13500	18000	22500	27000	22	5430	10860	21720	32580	43440	54300	65160
13	2550	5100	10200	15300	20400	25500	30600	23	5770	11540	23080	34620	46160	57700	69240
14	2850	5700	11400	17100	22800	28500	34200	24	6110	12220	24440	36660	48880	61100	73320

—Courtesy Martin-Decker Corporation, Long Beach, California.

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YOU can get a wire rope sling service from Hazard—never before available. First: the exact type of sling you need for your particular job—whether standard wire rope, braided wire rope, or cable-laid. And not only all the standard terminals but new, load-tested endings available from no other source.

More than this, *every* Hazard Registered Sling is proof-tested to twice its rated capacity. Then you may have a Certificate of Test and Registry which certifies to the sling's pre-determined safety. All Hazard Registered Slings are made of LAY·SET Preformed wire rope of Improved Plow Steel. Easy to handle; Acco-Registered for known strength.

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AMERICAN CHAIN & CABLE

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PRESENT WORTH OF FUTURE NET REVENUE—DISCOUNT CURVES

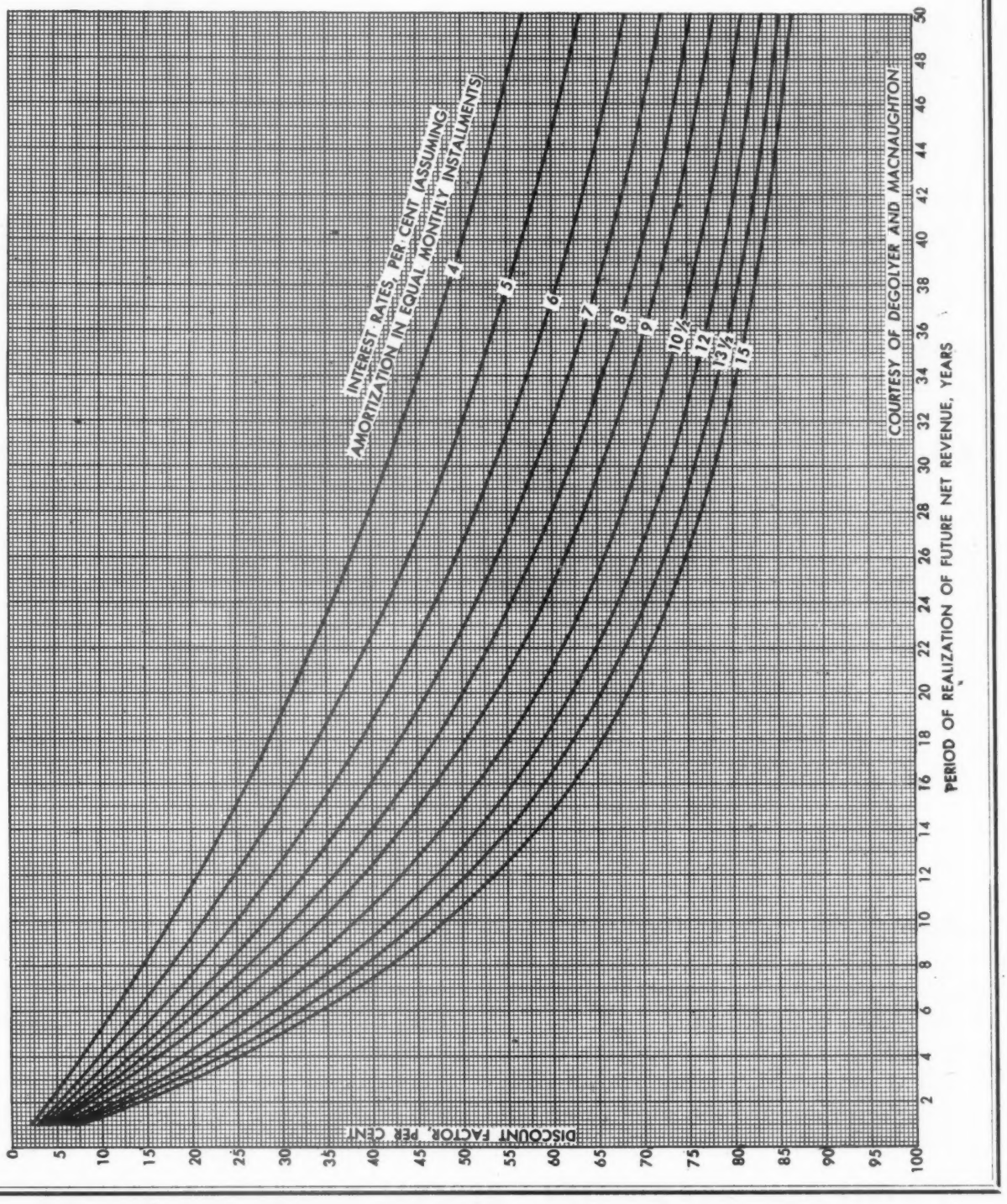
Example:

Given: Future net revenue = $100,000 to be received in equal monthly installments during next five years.

Wanted: To find the present value of the future net revenue if discounted at 12 per cent interest rate.

Solution: Enter the "Period of realization . . ." scale at the 5 year point. Follow up the 5 year line to its intersection with the 12 per cent interest line. Then read discount factor = 25 per cent on lefthand scale.

Answer: Present value of $100,000 under the given conditions = $\$100{,}00 \times \frac{100 - 25}{100} = \$75{,}000$.


INTEREST RATES, PER CENT (ASSUMING AMORTIZATION IN EQUAL MONTHLY INSTALLMENTS)
4
5
6
7
8
9
10½
12
13½
15
COURTESY OF DEGOLYER AND MACNAUGHTON
PERIOD OF REALIZATION OF FUTURE NET REVENUE, YEARS
DISCOUNT FACTOR, PER CENT
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50

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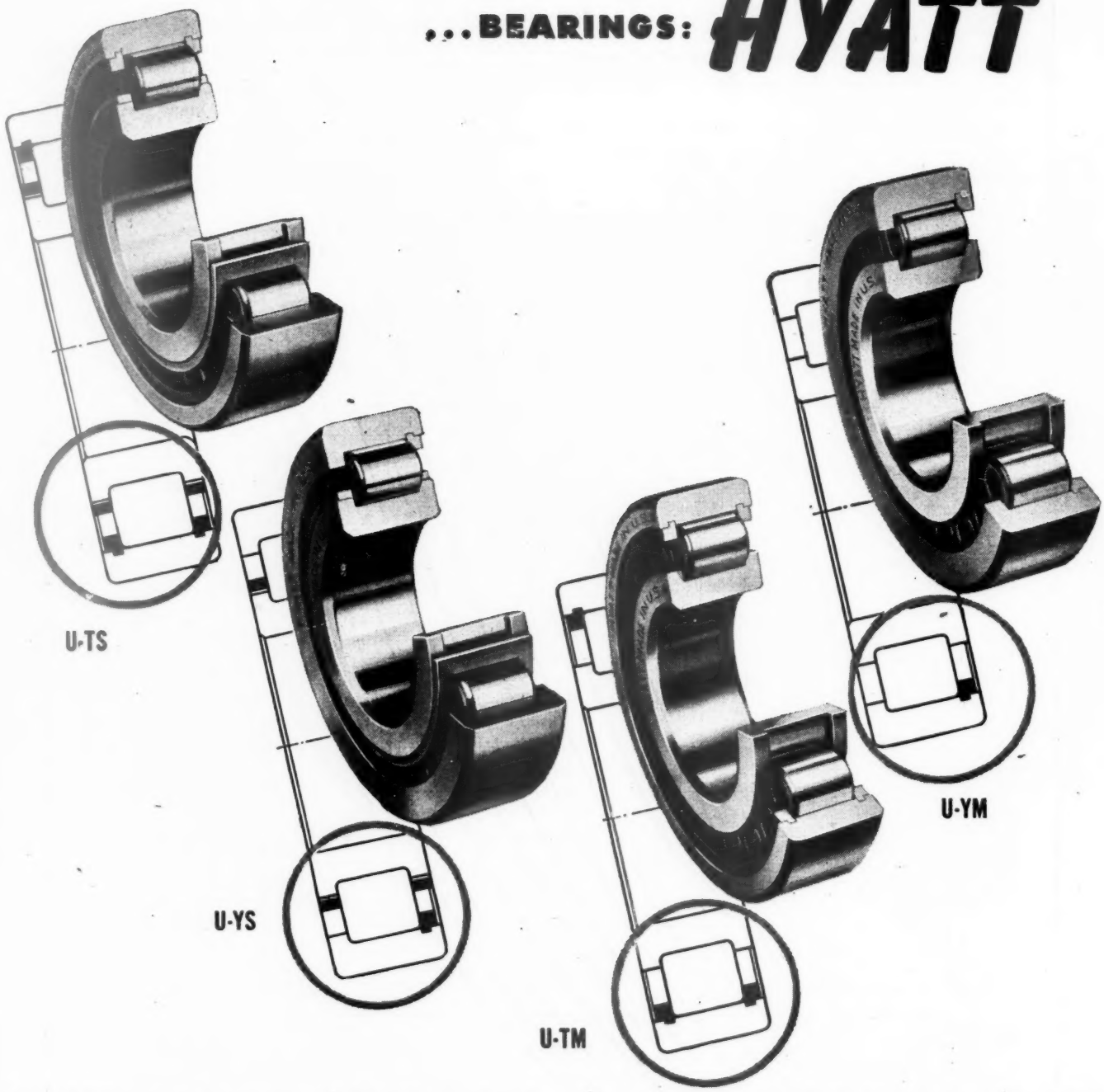

In addition to the range of Hyatt Hy-Load Roller Bearings of the separable type there is a complementary series of non-separable bearings for assembly as a complete unit.

These bearings as illustrated are the U-TS, U-YS, U-TM and U-YM. The first two are built with a roller separator and the latter two a full complement of rollers.

Thus no matter what type of radial roller bearing your design calls for there is a Hyatt Roller Bearing to meet your required specifications. Into each is built high load capacity with precision.

Let us give you any further details you may wish or send you a copy of the Hyatt Hy-Load Bearing Bulletin.

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VAPOR PRESSURE BLENDING CURVES FOR COMMERCIAL BUTANE

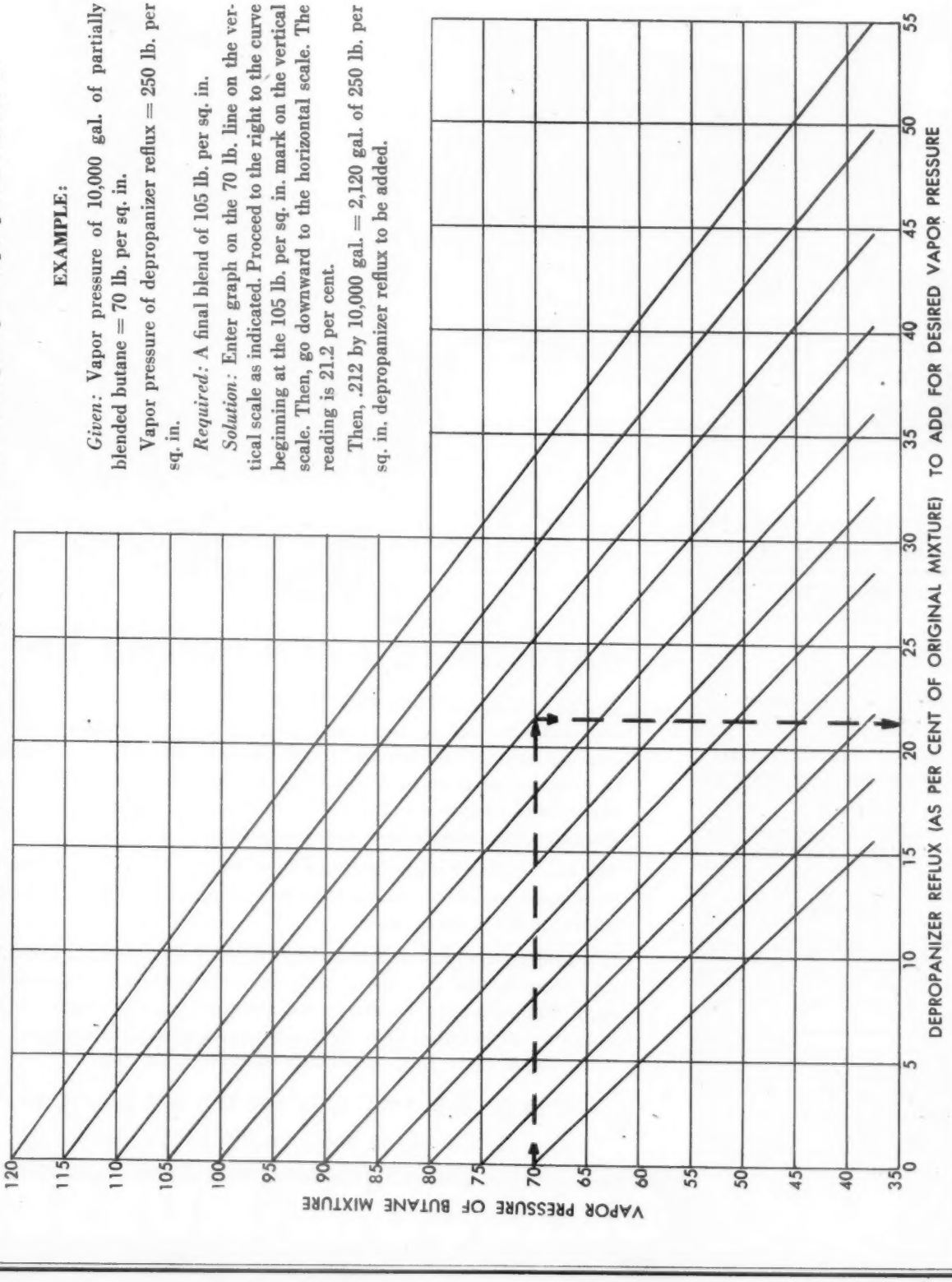


FIG. 5. Blending curves for butane mixture and depropanizer reflux of 250 lb. per sq. in. vapor pressure at 100°F.

EXAMPLE:

Given: Vapor pressure of 10,000 gal. of partially blended butane = 70 lb. per sq. in.

Vapor pressure of depropanizer reflux = 250 lb. per sq. in.

Required: A final blend of 105 lb. per sq. in.

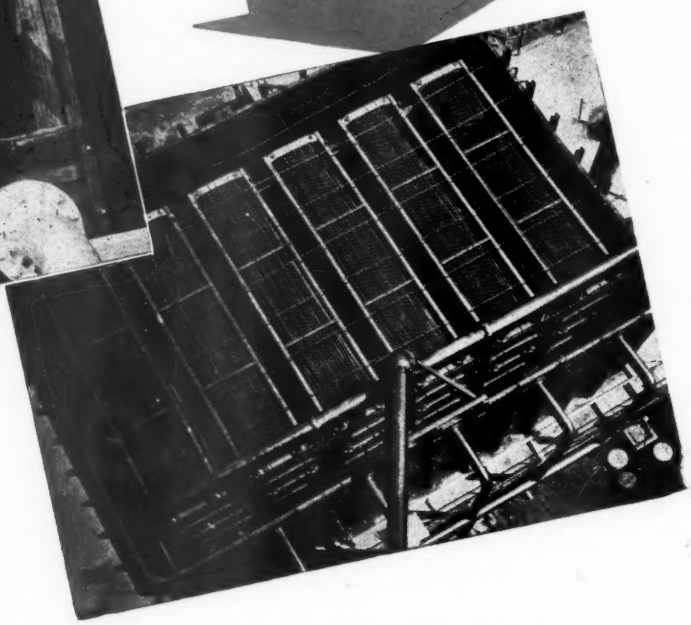
Solution: Enter graph on the 70 lb. line on the vertical scale as indicated. Proceed to the right to the curve beginning at the 105 lb. per sq. in. mark on the vertical scale. Then, go downward to the horizontal scale. The reading is 21.2 per cent.

Then, .212 by 10,000 gal. = 2,120 gal. of 250 lb. per sq. in. depropanizer reflux to be added.

G-R BENTUBE SECTIONS

ATMOSPHERIC

SUBMERGED



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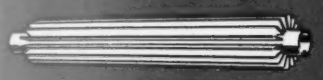

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The 8,000 G-R BENTUBE SECTIONS in service have a lengthy and extensive record of successful performance . . . condensing or cooling over six million gallons of gasoline per day . . . operating in compressor stations of pipe line systems carrying four-fifths of the natural gas used in the United States . . . installed at more than 300 refineries and natural gas companies.

The vast amount of engineering data resulting from these installations assures authoritative ratings and permits definite capacity guarantees for these units.

In addition, the proven BENTUBE SECTION superiorities of design and construction . . . their exclusive scale-shedding feature, exceptional durability, compactness, convenience of installation and economy of maintenance further warrant your investigation. Write for Bulletin 1601 describing these units in detail.

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GRISCOM-RUSSELL

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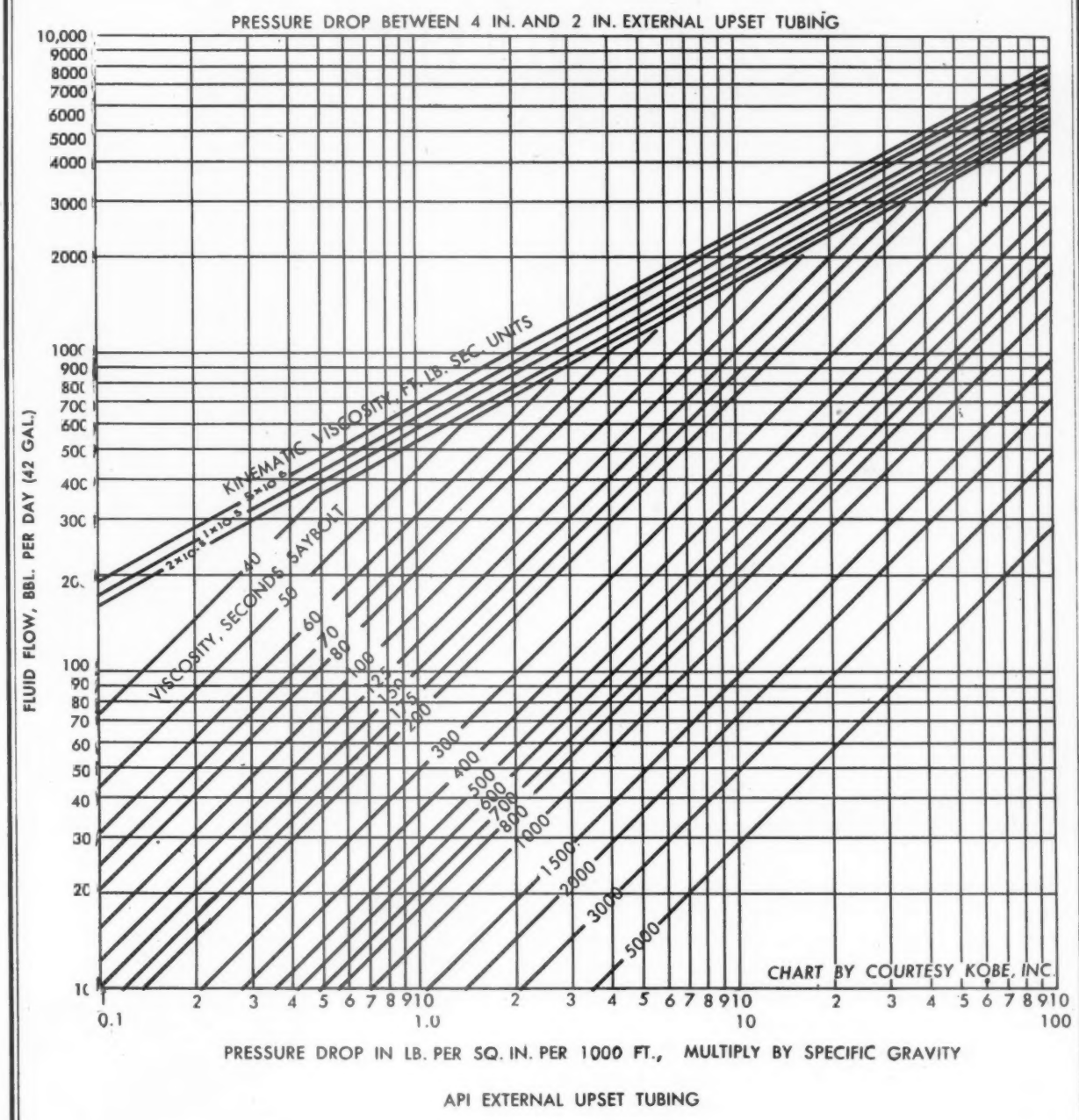

Note: This chart is not applicable in cases where gas is present in sufficient quantity to break out of solution, or where the fluid characteristics are not uniform.

Example:

Given: Rate of flow = 100 bbl. per day
Viscosity of fluid = 100 sec. Saybolt
Specific gravity = 0.82

Wanted: Pressure drop through 5000 ft. of annulus between 4-in. and 2-in. API external upset tubing.

Solution: Beginning at the 100 bbl. per day point on the fluid flow scale follow the horizontal line to the right to the point where this line crosses the 100 viscosity-sec. Saybolt line. Continue straight downward from this point and read the pressure drop = .65 lb. Multiply this figure by 0.82 gravity. This gives the pressure drop per 1000 ft. under these conditions = .533 lb. Multiply the result by 5 (the number of 1000's of ft.). The answer is the result of the last multiplication:

The pressure drop = 2.66 lb. through 5000 ft. of annulus between 4-in. and 2-in. E.U.E. tubing when the rate of flow is 100 bbl. per day, the viscosity 100 sec. Saybolt, and the specific gravity 0.82.

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VAPOR PRESSURE BLENDING CURVES FOR COMMERCIAL BUTANE

EXAMPLE OF CHART USE:

Given:

Vapor pressure of 10,000 gal. of partially blended butane = 70 lb. per sq. in.

Vapor pressure depropanizer reflux = 225 lb. per sq. in.

Required:

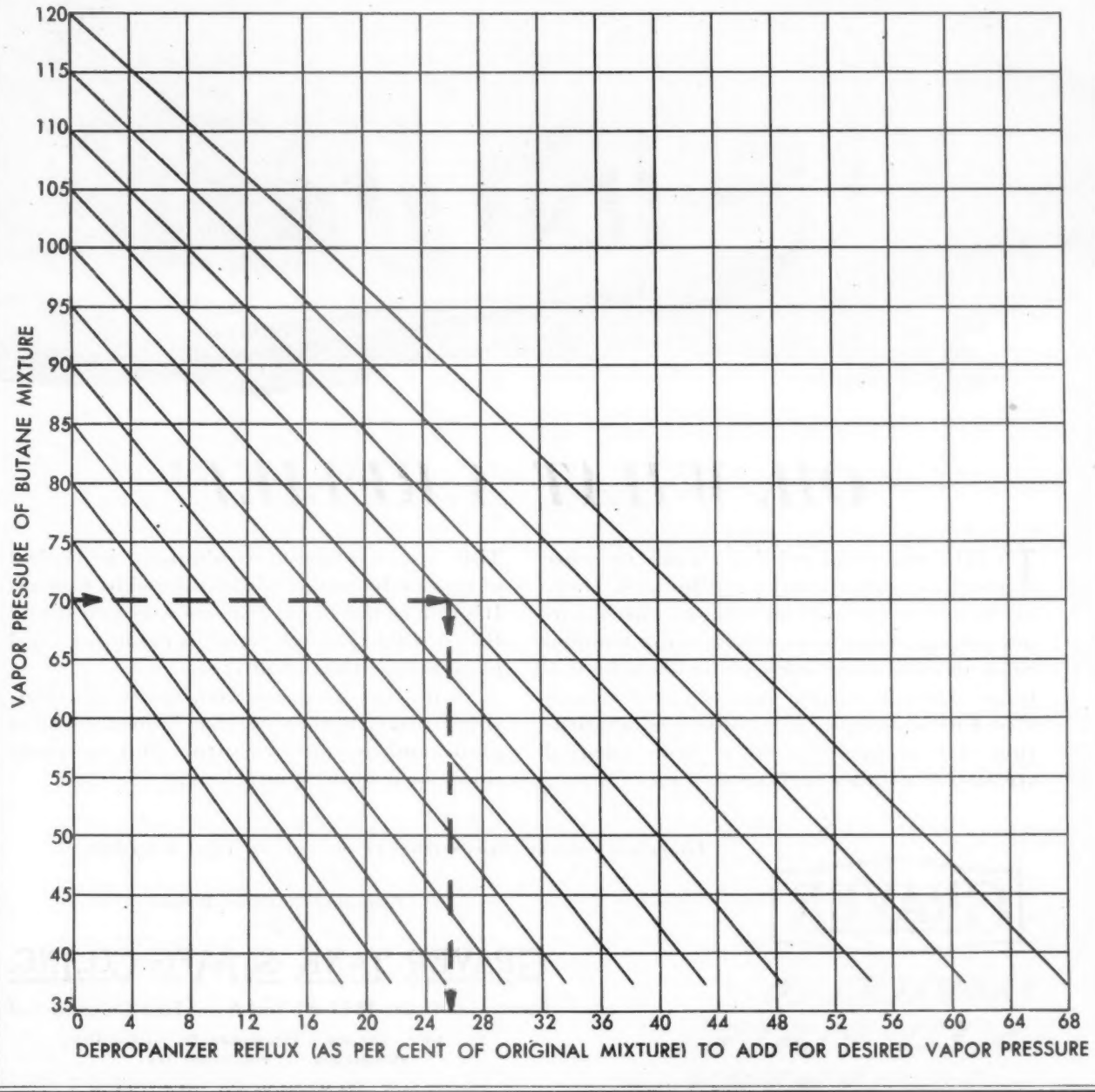
A final blend of 105 lb. per sq. in.

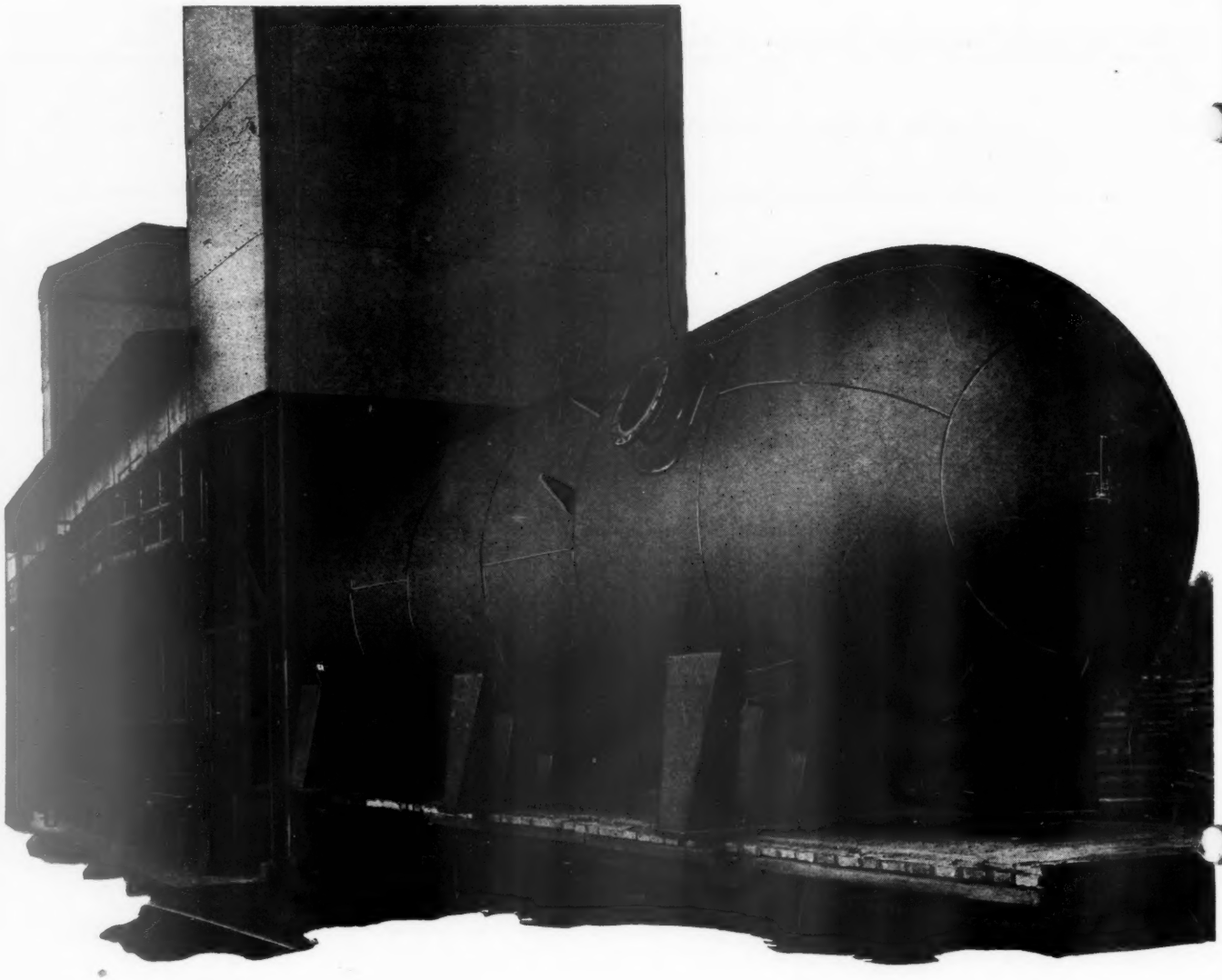
Solution:

Enter graph on the 70 lb. line on the vertical scale as indicated. Proceed to the right to the curve beginning at the 105-lb. mark on the vertical scale. Then, go downward to the horizontal scale. The reading is 25.5 per cent.

Then, .255 by 10,000 gal. = 2550 gal. of 225 lb. per sq. in. depropanizer reflux to be added.

FIG. 4. Blending curves for butane mixture and depropanizer reflux of 225 lb. per sq. in. at 100°F.





OH, WHAT A RELIEF!

IN THE process of welding a tank, pressure vessel, or other similar equipment, there are bound to be residual stresses which, under certain conditions, might cause trouble. Such stresses are quickly neutralized by this huge stress relieving furnace at Graver's East Chicago plant. The controlled application of heat frees the vessel from unequal strains even under high pressure use.

This stress-relieving equipment is typical of the service and facilities offered by Graver. It's one of the many reasons why you'll find this a mighty good place to come for steel plate fabrication of all types.

No matter what your requirements, consult Graver. If they call for fabricated steel plate send us your blueprints and specifications for prompt quotations.

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GRAVER

FABRICATED STEEL PLATE EQUIPMENT

Fabricated Steel Plate Division
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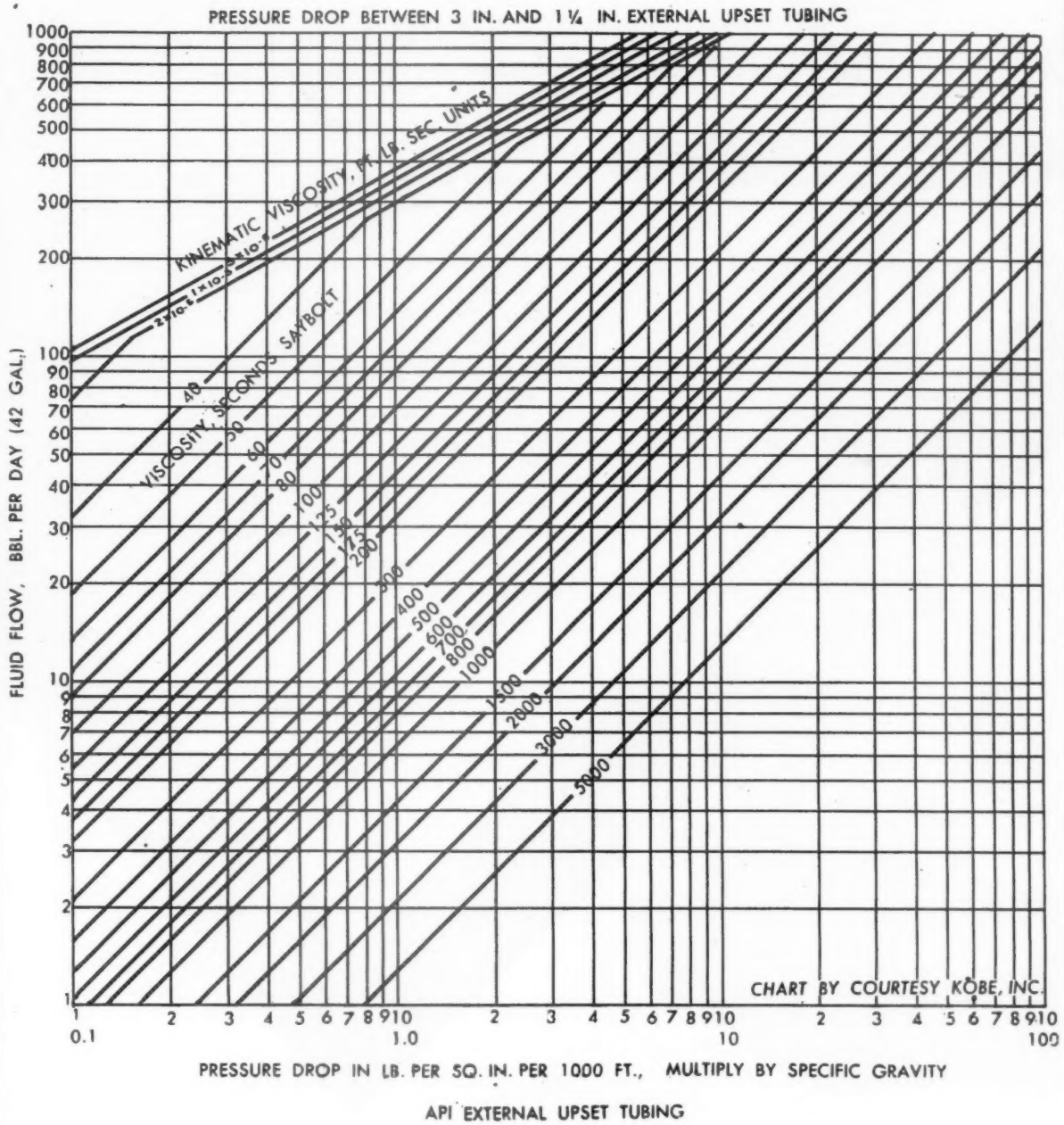
PRESSURE DROP CALCULATION CHARTS


PRESSURE DROP BETWEEN 3 IN. AND 1 ¼ IN. EXTERNAL UPSET TUBING
FLUID FLOW, BBL. PER DAY (42 GAL.)
KINEMATIC VISCOSITY, FT. LB. SEC. UNITS
VISCOSITY, SECONDS SAYBOLT
CHART BY COURTESY KOBE, INC.
PRESSURE DROP IN LB. PER SQ. IN. PER 1000 FT., MULTIPLY BY SPECIFIC GRAVITY
API EXTERNAL UPSET TUBING

Note: This chart is not applicable in cases where gas is present in sufficient quantity to break out of solution, or where the fluid characteristics are not uniform.

Example:

Given: Rate of flow = 100 bbl. per day
Viscosity of fluid = 100 sec. Saybolt
Specific gravity = 0.82

Wanted: Pressure drop through 5000 ft. of annulus between 3-in. and 1¼-in. API external upset tubing.

Solution: Beginning at the 100 bbl. per day point on the fluid flow scale follow the horizontal line to the right to the point where this line crosses the 100 viscosity-sec. Saybolt line. Continue straight downward from this point and read the pressure drop = 1.5 lb. Multiply this figure by 0.82 gravity. This gives the pressure drop per 1000 ft. under these conditions = 1.23 lb. Multiply the result by 5 (the number of 1000's of ft.). The answer is the result of the last multiplication:

The pressure drop = 6.15 lb. through 5000 ft. of annulus between 3-in. and 1¼-in. E.U.E. tubing when the rate of flow is 100 bbl. per day, the viscosity 100 sec. Saybolt, and the specific gravity 0.82.

Specialists IN STEEL CASTINGS FOR VALVES—FITTINGS

● A sharp upswing in temperatures and pressures began nearly half a century ago. The need for cast steel valves and fittings became apparent. And that's when Reading began to specialize in *pressure* steel castings.

Early development was a matter of experimenting, recording experience and studying the records. But, as pressures and temperatures continued to rise, the demand was for ever higher standards in valves. Reading met the challenge with improved manufacturing methods. Melting processes were refined from converters to open hearth furnaces, then to electric furnaces. Control and investigational methods, such as photomicrographs, radiography, new methods of sand-testing and slag control were developed and improved.

Such developments produced castings in either carbon steels or alloys to use in valves to meet today's exacting requirements—valves and fittings which safely and reliably handle present-day high temperatures in the steam services and the gases and oils of the petroleum industry.

R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and Lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Regulating Valves.

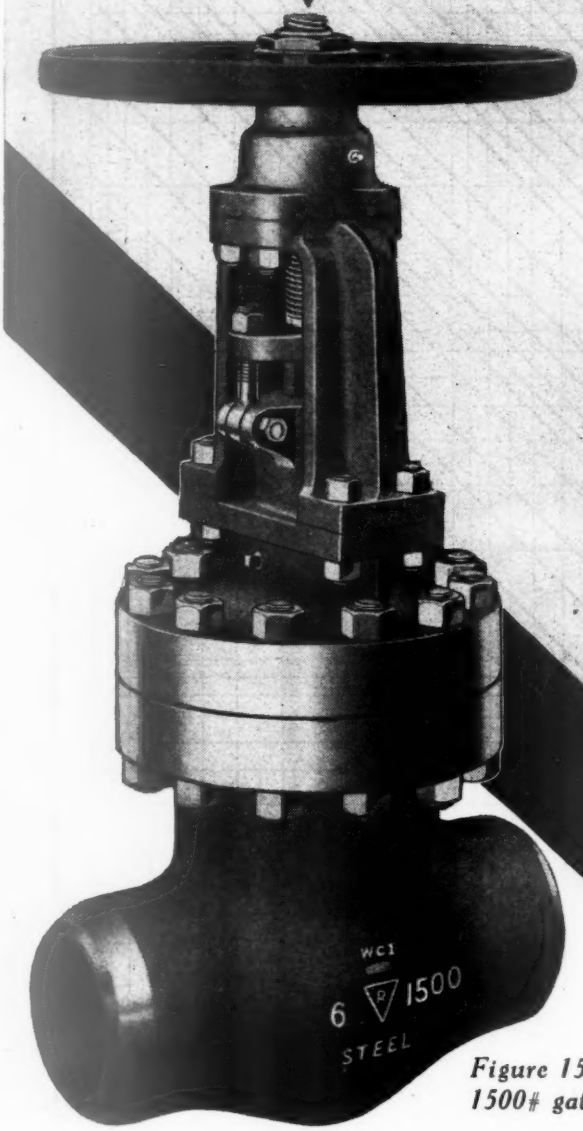


Figure 15004
1500# gate valve

READING-PRATT & CADY

MANUFACTURERS OF
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AMERICAN CHAIN & CABLE

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WEIGHT INDICATOR CONVERSION TABLES

TABLE 3. Conversion table for gage readings on weight indicator with 1¼-in. cable—*Continued.*

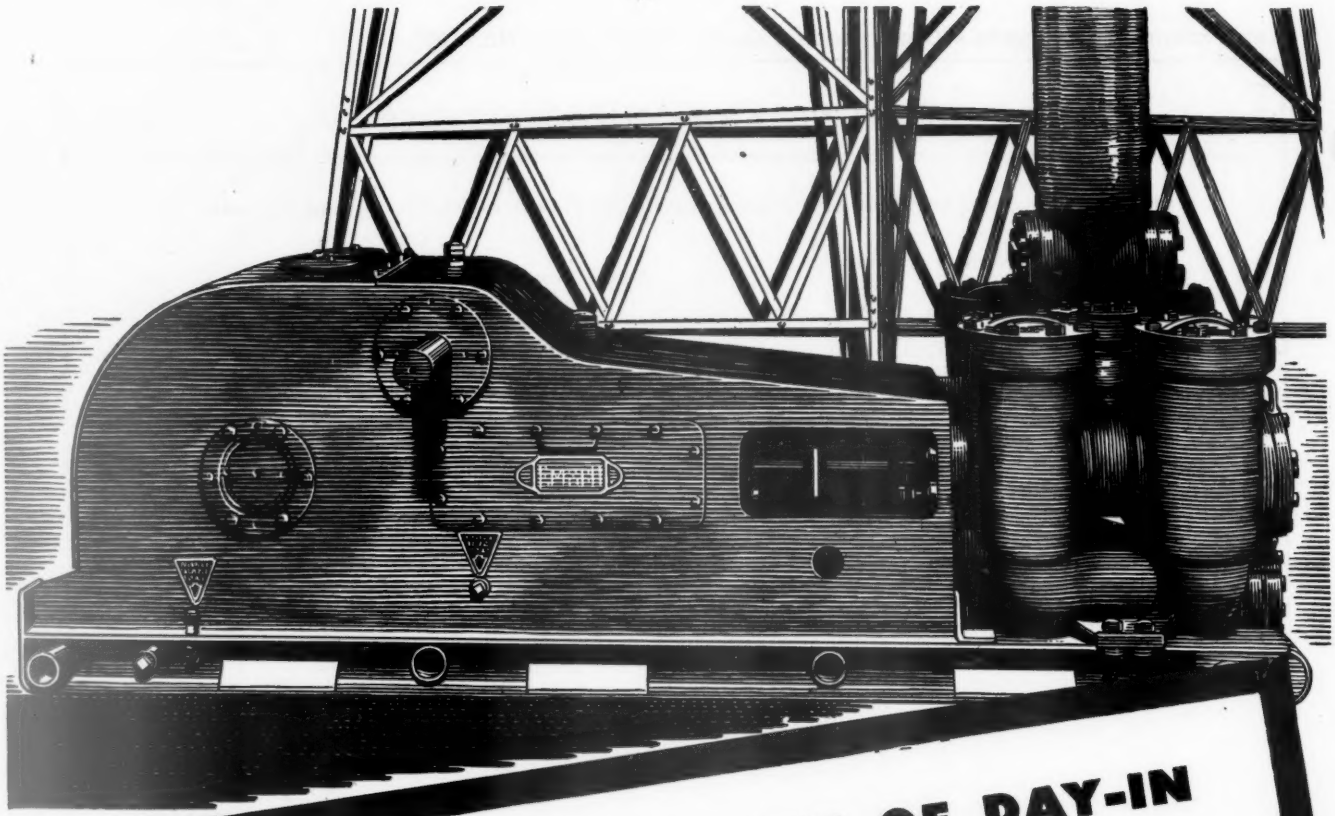
Gage reading points	Number of lines						
	1	2	4	6	8	10	12
25	6450	12900	25800	38700	51600	64500	77400
26	6800	13600	27200	40800	54400	68000	81600
27	7150	14300	28600	42900	57200	71500	85800
28	7500	15000	30000	45000	60000	75000	90000
29	7850	15700	31400	47100	62800	78500	94200
30	8200	16400	32800	49200	65600	82000	98400
31	8560	17120	34240	51360	68480	85600	102720
32	8920	17840	35680	53520	71360	89200	107040
33	9280	18560	37120	55680	74240	92800	111360
34	9640	19280	38560	57840	77120	96400	115680
35	10000	20000	40000	60000	80000	100000	120000
36	10390	20780	41560	62340	83120	103900	124680
37	10780	21560	43120	64680	86240	107800	129360
38	11170	22340	44680	67020	89360	111700	134040
39	11560	23120	46240	69360	92480	115600	138720
40	11950	23900	47800	71700	95600	119500	143400
41	12360	24720	49440	74160	98880	123600	148320
42	12770	25540	51080	76620	102160	127700	153240
43	13180	26360	52720	79080	105440	131800	158160
44	13590	27180	54360	81540	108720	135900	163060
45	14000	28000	56000	84000	112000	140000	168000
46	14440	28880	57760	86640	115520	144400	173280
47	14880	29760	59520	89280	119040	148800	179560
48	15320	30640	61280	91920	122560	153200	183840
49	15760	31520	63040	94560	126080	157600	189120
50	16200	32400	64800	97200	129600	162000	194400
51	16650	33300	66600	99900	133200	166500	199800
52	17100	34200	68400	102600	136800	171000	205200
53	17550	35100	70200	105300	140400	175500	210600
54	18000	36000	72000	108000	144000	180000	216000
55	18450	36900	73800	110700	147600	184500	221400
56	18925	37850	75700	113550	151400	189250	227100
57	19400	38800	77600	116400	155200	194000	232800
58	19875	39750	79500	119250	159000	198750	238500
59	20350	40700	81400	122100	162800	203500	244200
60	20825	41650	83300	124950	166600	208250	249900
61	21310	42620	85240	127860	170480	213100	255720
62	21795	43590	87180	130770	174360	217950	261540
63	22280	44560	89120	133680	178240	222800	267360
64	22765	45530	91060	136590	182120	227650	273180

Gage reading points	Number of lines						
	1	2	4	6	8	10	12
65	23250	46500	93000	139500	186000	232500	279000
66	23740	47480	94960	142440	189920	237400	284880
67	24130	48260	96520	144780	193040	241300	289560
68	24620	49240	98480	147720	196960	246200	295440
69	25110	50220	100440	150660	200880	251100	301320
70	25700	51400	102800	154200	205600	257000	308400
71	26235	52470	104940	157410	209880	262350	314820
72	26770	53540	107080	160620	214160	267700	321240
73	27305	54610	109220	163830	218440	273050	327660
74	27840	55680	111360	167040	222720	278400	334080
75	28375	56750	113500	170250	227000	283750	340500
76	28920	57840	115680	173520	231360	289200	347040
77	29465	58930	117860	176790	235720	294650	353580
78	30010	60020	120040	180060	240080	300100	360120
79	30555	61110	122220	183330	244440	305555	366660
80	31100	62200	124400	186600	248800	311000	373200
81	31660	63320	126640	189960	253280	316600	379920
82	32220	64440	128880	193320	257760	322200	386640
83	32780	65560	131120	196680	262240	327800	393360
84	33340	66680	133360	200040	266720	333400	400080
85	33900	67800	135600	203400	271200	339000	406800
86	34490	68980	137960	206940	275920	344900	413880
87	35080	70160	140320	210480	280640	350800	420960
88	35670	71340	142680	214020	285360	356700	428040
89	36260	72520	145040	217560	290080	362600	435120
90	36850	73700	147400	221100	294800	368500	442200
91	37455	74910	149820	224730	299640	374550	449460
92	38060	76120	152240	228360	304480	380600	456720
93	38665	77330	154660	231990	309320	386650	463980
94	39270	78540	157080	235620	314160	392700	471240
95	39875	79750	159500	239250	319000	398750	478500
96	40480	80960	161920	242880	323840	404800	485760
97	41085	82170	164340	246510	328680	410850	493020
98	41690	83380	166760	250140	333520	416900	500280
99	42395	84790	169580	254370	339160	423950	508740
100	42900	85800	171600	257400	343200	429000	514800

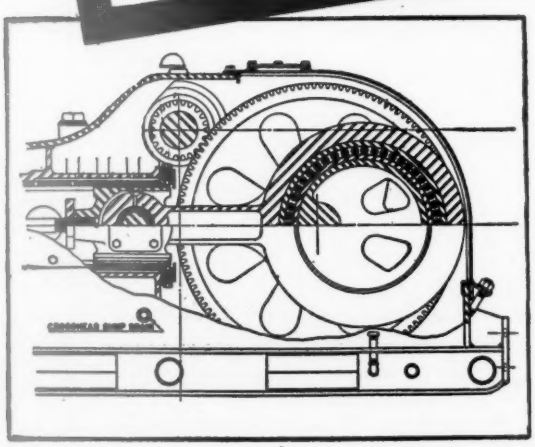
Average value of one indicator point in pounds for obtaining bit pressure in pounds—1¼-in. drilling line.

Between gage readings below	Number of lines						
	1	2	4	6	8	10	12
5–10	290	580	1160	1740	2320	2900	3480
10–20	310	620	1240	1860	2480	3100	3720
20–30	345	690	1380	2070	2760	3450	4140
30–40	375	750	1500	2250	3000	3750	4500
40–50	425	850	1700	2550	3400	4250	5100
50–60	463	926	1852	2778	3704	4630	5556
60–70	488	976	1952	2928	3904	4880	5856
70–80	540	1080	2160	3240	4320	5400	6480
80–90	575	1150	2300	3450	4600	5750	6900
90–100	605	1210	2420	3630	4840	6050	7260

—Courtesy Martin-Decker Corporation, Long Beach, California.



STANDING THE STRAIN OF DAY-IN AND DAY-OUT PUMPING DUTY



X-Section of the Emsco 7¼ x 12 Power Slush Pump shows the location of the 20" I. D. x 25" O. D. Torrington Radial Roller Bearing under eccentric strap. This bearing has a capacity of 187,000 lbs. at 100 R.P.M. Note also the compact Torrington Type NCS Needle Bearing on the wrist pin. The use of sturdy, long-life Torrington Bearings in pumping and other heavy-duty machinery assures efficient, trouble-free operation with a minimum output in power.

No matter how severe service conditions on a job may be, there are Torrington Bearings that can handle the loads efficiently with a minimum of maintenance attention. Take, for example, this Emsco 7¼ x 12 Power Slush Pump. The Torrington Radial Roller Bearing used under the eccentric strap makes the pumping operation easier and helps this machine stand the gaff of constant daily use. A Torrington Type NCS Needle Bearing is also used on the wrist pin of the cross head.

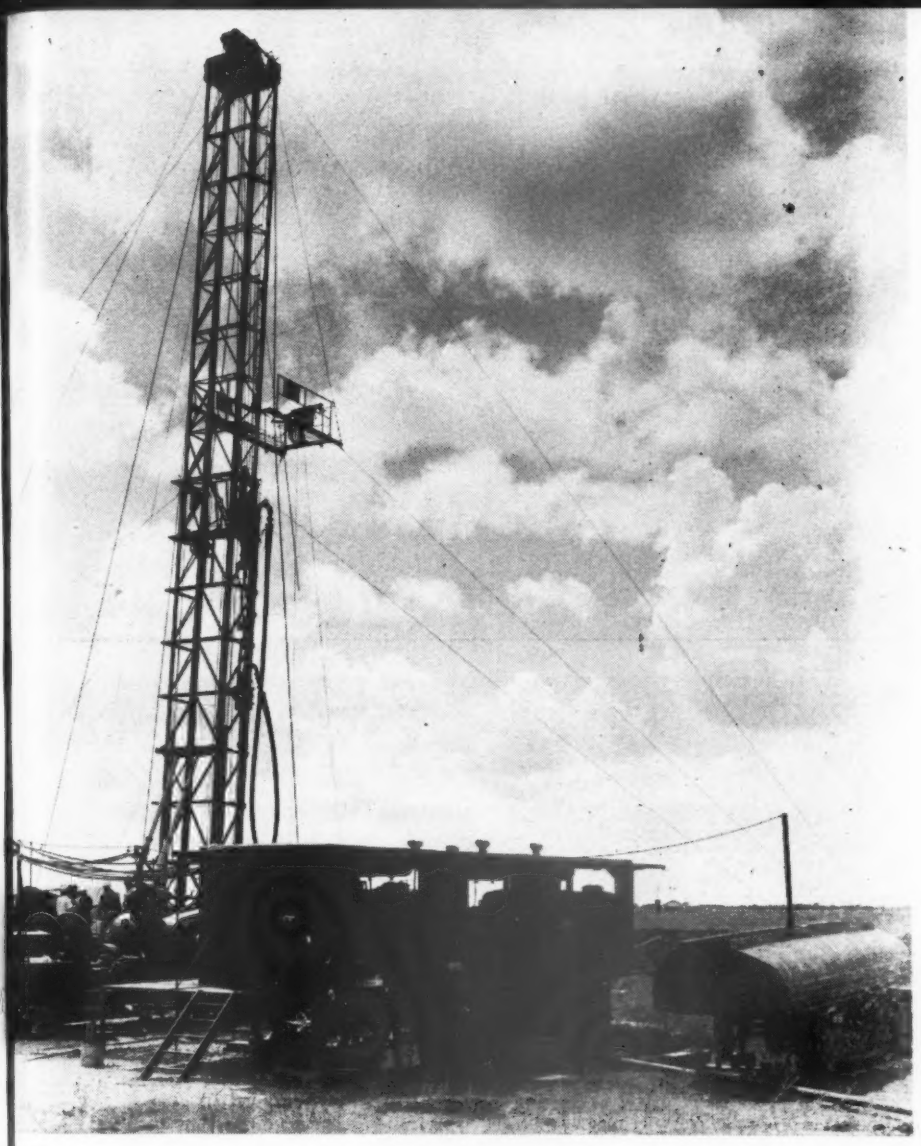
In many industries, similar examples could be cited of the sturdiness and high-load capacity of Torrington Bearings, because they are designed to stand up to the job through years of exacting service. These and many other Torrington Bearing advantages can be incorporated in the oil field equipment *you* design, build or operate. It will pay you to bring your anti-friction problems to Torrington's Bantam Bearings Division . . . where you can profit by our years of specialized experience in the design and manufacture of large, custom-built bearings for routine or unusual jobs.

THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

TORRINGTON BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

NEW DRILLING RIG



Above—The 90-ft. derrick erected to position for drilling. Below—Piston-type mud pump is powered by a 200-hp. electric motor.

BELIEVED to be new in the oil industry is a complete unit developed for the Rowan Drilling Company by engineers of Lufkin Foundry and Machine Company, Lufkin, Texas.

The complete unit consists of a power unit, fuel oil trailer, mud pump trailer, derrick trailer, and two self-loading floats.

The power unit is a 32-ft. tandem trailer, equipped with four 60-kw. Westinghouse d-c generators and master control handles. These generators are powered by four 100-hp. General Motors diesel engines.

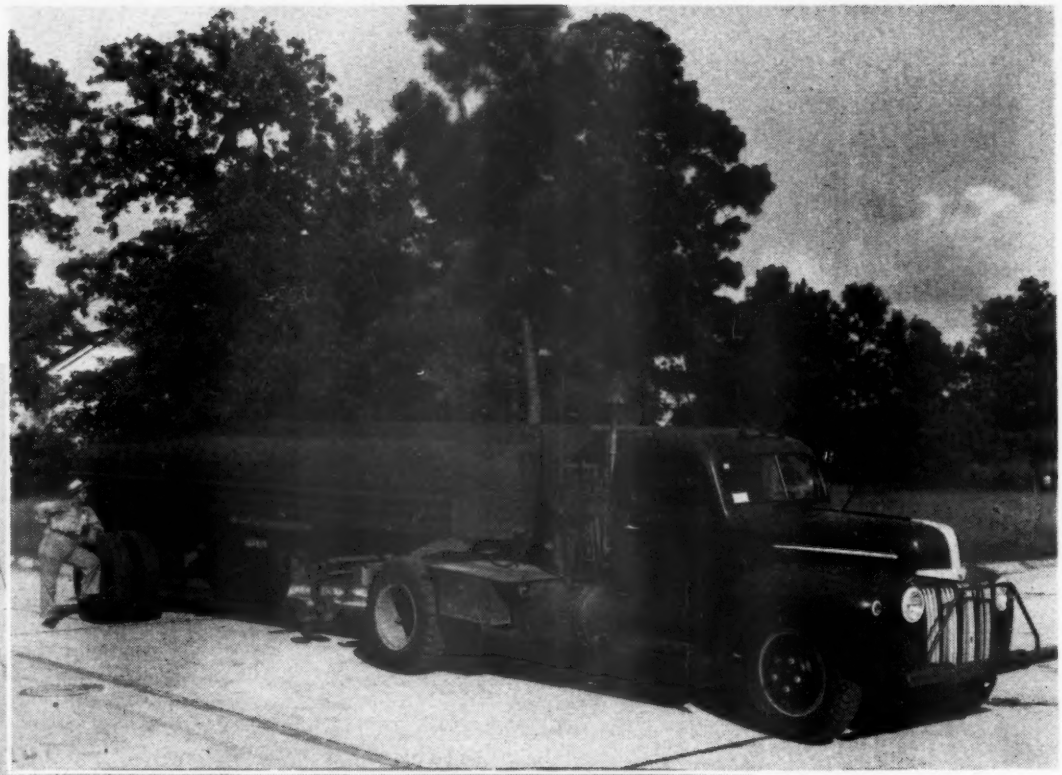
The fuel oil trailer is of 2500-gal. capacity with four 100-gal. lubricating oil compartments.

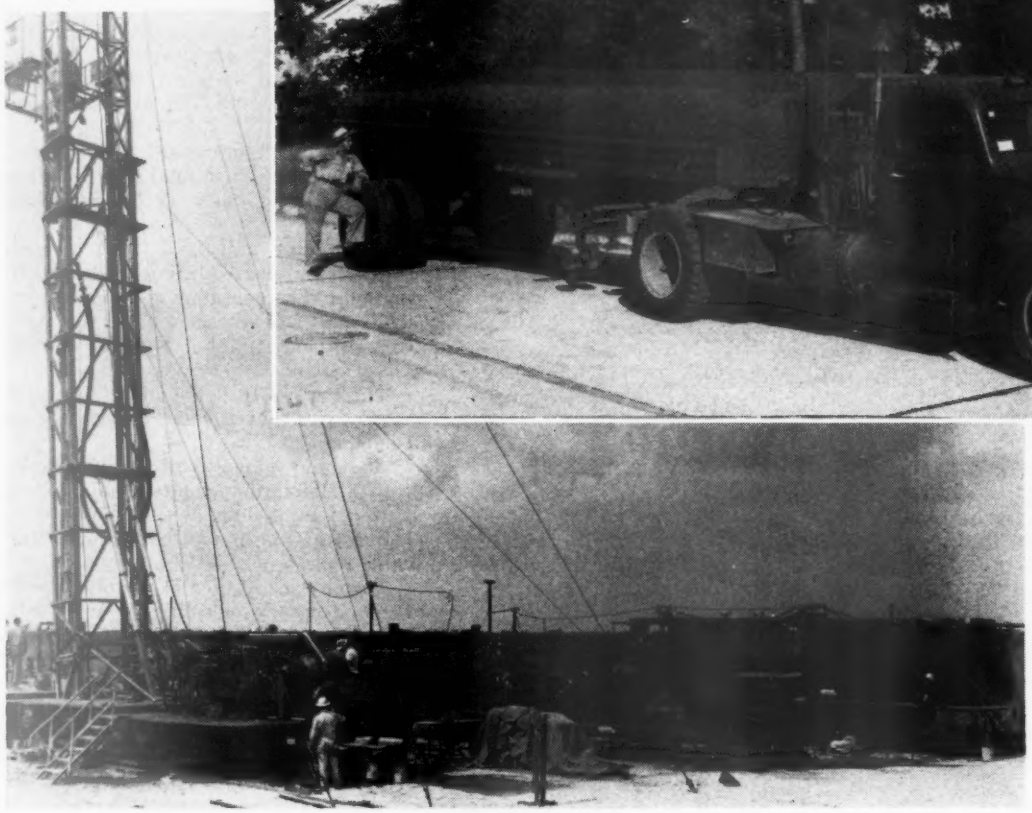
The mud pump trailer is equipped with a standard piston-type mud pump powered by 200-hp. Westinghouse electric motor, a large tool box, and electric cable reels.

The derrick trailer is equipped with Ideco derrick, consisting of two 45-ft. sections with telescope, making a 90-ft. derrick. The crown block is of 25,000-lb. capacity. The drawworks on the derrick trailer are powered by a 200-hp. Westinghouse electric motor. The entire unit is capable of drilling to a depth of 7500 ft.

The two self-loading floats carry the

The fuel oil trailer has a capacity of 2500 gal. (right). Below — General view of the new drilling rig.





rotary mounted on substructure. These floats also carry the crown block, swivel, cable, and all other equipment.

All mobile trailer units were developed and manufactured in the trailer division of the Lufkin Foundry and Machine Company.

The first well on which this equipment was used was spudded in September 20 in the Gulf Coast area.

★ ★ ★

P 615.1

MEASURING OIL FLOW FROM HORIZONTAL PIPE WITHOUT METER

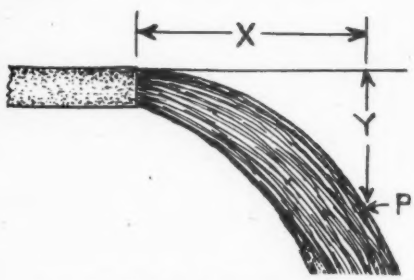
By **W. F. Schaphorst**

QUANTITY of gasoline, kerosine, crude oil, water, and many other liquids flowing from a horizontal pipe, as shown in the accompanying sketch, can be computed with surprising accuracy by simply measuring the horizontal distance X and the vertical distance Y to any convenient point P as indicated in the sketch.

This is possible because of the well known law of physics that a horizontally projected body falls at precisely the same rate as does a body that is dropped vertically from a state of rest.

Following through the derivation of the formulas that result directly from the laws of falling bodies, we get this one:

Where: $v = \frac{1.16\,X}{\sqrt{Y}}$



v = velocity in feet per second of the liquid at the mouth of the pipe,
X = the horizontal distance to point P measured in inches,
Y = the vertical distance to point P, also measured in inches.

Then, based on the above formula and introducing diameter of the pipe, we get

$$G = \frac{2.56\,D^2\,X}{\sqrt{Y}}$$

Where:
G = number of gallons of liquid flowing from the pipe per minute and
D = the internal diameter of the pipe, measured in inches.

For example, if D is 2 in., X is 20 in., and Y is 25 in., it will be found that the flow is 40.96 gal. per min.

A short cut that will make the work a bit easier is to choose a point P that is down a distance 9 in., 16 in., 25 in., or 36 in., etc., because their square roots are exactly 3, 4, 5, and 6, respectively. In that way it will not be necessary to refer to tables of square roots or to extract arduously a square root by figuring.

25 TO 30 H.P.
6000 H.P.
Dependable Service -
ANOTHER REASON FOR YOUNG, HAPPY LEADERSHIP
If accident or abuse should require replacements of damaged parts, these may be quickly secured from our various stocks.
We invite you to submit your Cooling Problems to us.

Rubber Belting
Leather Belting
V Belts
V Belt Sheaves
Happy Pumping Units
Power Transmission Equipment

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Kilgore	Texas
Pampa	Texas
Salem	Illinois
Wichita	Kansas
Ellinwood	Kansas

A slough is no obstacle to a pipeliner. He simply makes a solid crossing with timbers and proceeds with his work.

P 623.

NEW PIPE LINE OUTLET FROM CARTHAGE FIELD

By FRANK H. LOVE
Managing Editor

EXCLUSIVE

By the time this appears in print United Gas Pipe Line Company's 24-in. pipe line from the Carthage gas field, Texas, to Sterlington, Louisiana, will be in its final stages of completion. The system, which is the first main transmission line to be laid directly from the field since that vast gas reserve was discovered, is scheduled to be placed in operation during the month of November.

The new line, 142 miles in length, will have a maximum capacity of 310,000,000 cu. ft. a day. Later, as conditions may dictate, this capacity can be increased to 395,000,000 cu. ft. by the installation of an 8000-hp. compressor station. Full capacity will not be utilized initially, however. At the outset 114,000,000 cu. ft. will be received from the natural gasoline plant of The Chicago Corporation, now under construction, and delivered at Monroe, Louisiana, to Tennessee Gas and Transmission Company. The balance will be taken from an absorption-type gasoline plant being erected in the field for United. This gas will go to Sterlington, being dehydrated before it enters the line at Carthage. At maximum capacity the line will be operated from a maximum well delivery pressure of 1200 lb. The gas enters the gasoline plant at a pressure of 1050 lb. and is discharged from the dehydration plant into the transmission line at a maximum pressure of 1000 lb. Discharge pressure at Sterlington will be at 500 lb.

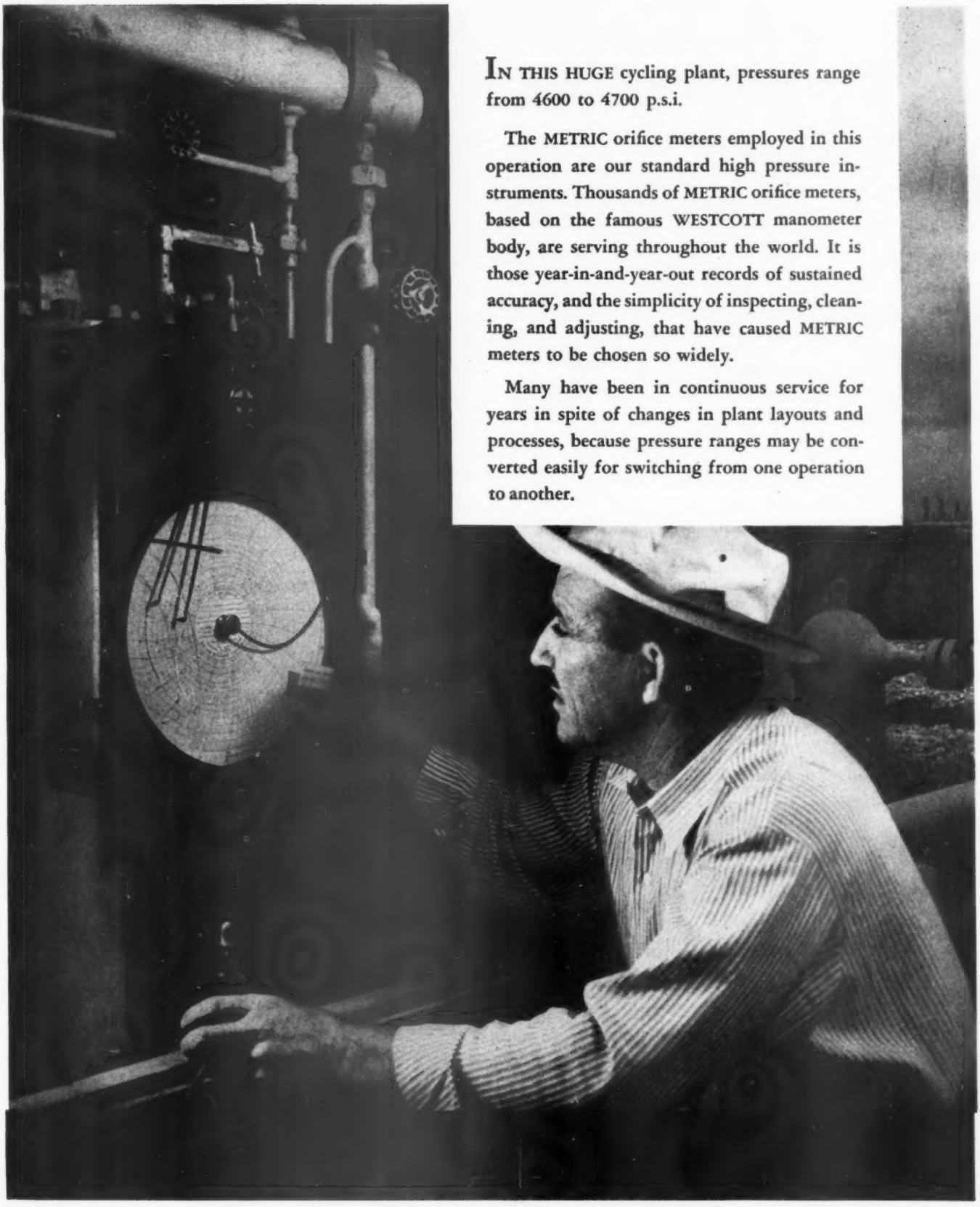
Construction of the line from Carthage to Sterlington will serve several purposes. It will provide a major outlet for one of the world's large gas fields, reserves of which are estimated to be approximately 5 trillion cubic feet. Further, the 114,000,000 cu. ft. of gas delivered into the Tennessee line at Monroe will reduce the withdrawals from the Stratton-Agua Dulce area of South Texas inasmuch as Tennessee's principal supply has been from this area. This factor is considered to be in the interest of broad conservation objectives. In addition, the balance of the line's delivery going to Sterlington will augment United's supply to its customers in the Monroe area, a move made necessary by the decline in gas reserves and deliverability of wells in the Monroe field. In passing, it is of value for the record to note that during the period from September, 1942, to September, 1944, the deliverability of the wells available to United in the Monroe field, exclusive of those in the low pressure area, declined on an average of about 23 per cent a year, and that the estimated decline between the winters of 1945 and 1946 would be about 25 per cent.

● **Gathering system.** Included in the gathering system pipe lines are 16 miles of 20-in., 16 miles of 16-in., 12 miles of 12-in., 5 miles of 10-in., 14 miles of 8-in., and 40 miles of 6-in., making a total of 103 miles. The project at present includes the construction of facilities to handle the production of the Union Producing Company, Southern Production Company, and Skelly Oil Company, and may be extended in the future to include gas from other producers. The system has been designed for a maximum operating pressure of 1200-lb.

● **Main line route.** The main line, which is approximately 142 miles in length, extends eastward from the Carthage field to East Point, Louisiana, where the route takes a northeast direction. After reaching Monroe, where part of the load will be discharged to Tennessee, the line turns more sharply northeast and extends to Sterlington. For the most part the line is being laid through a sandy loam type of soil with a consid-

(Continued on Page 334)

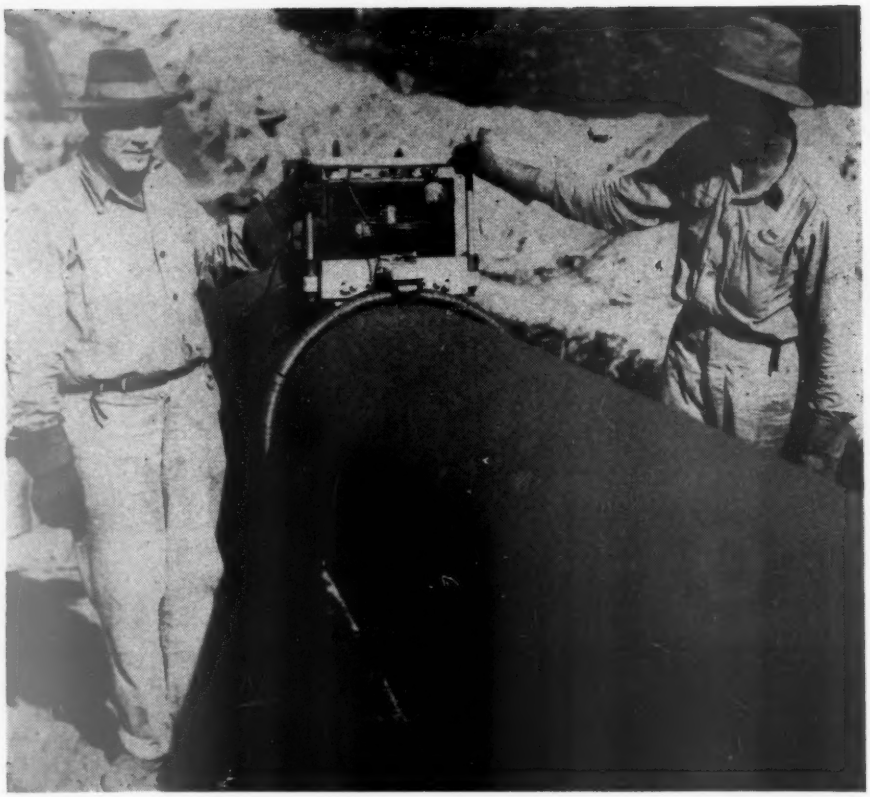
the measure of a meter



IN THIS HUGE cycling plant, pressures range from 4600 to 4700 p.s.i.

The METRIC orifice meters employed in this operation are our standard high pressure instruments. Thousands of METRIC orifice meters, based on the famous WESTCOTT manometer body, are serving throughout the world. It is those year-in-and-year-out records of sustained accuracy, and the simplicity of inspecting, cleaning, and adjusting, that have caused METRIC meters to be chosen so widely.

Many have been in continuous service for years in spite of changes in plant layouts and processes, because pressure ranges may be converted easily for switching from one operation to another.



Only two men are necessary to operate this electronic holiday detector.

(Continued from Page 330)

erable part of the route through wooded areas. The route also traverses a number of bayous and rivers.

● **River crossings.** The principal water crossings are the Sabine River, Bayou Pierre, Red River, Loggy Bayou, Bayou D'Arbonne, and the Ouachita River.

The Red River crossing will be a suspension bridge having a 1600-ft. span between main piers and a 56-ft. clearance above mean high water. The bridge is designed to carry two 24-in. lines. The ground elevation at the main pier on the west side of the river is 146 ft. with the top of the pier at 152 ft. The bottom of piling for this pier is founded in shale at an elevation of 53 ft. Twin caissons are spaced 36 ft. center-to-center of the main pier. These caissons, are 50 ft. long and in each have been driven twenty 60-ft. H-beam piles. The caissons were excavated to bottom and 8-ft. concrete seals placed. After the seal had set the caissons were dewatered and poured full of concrete.

The concrete cap on the main pier caisson extends upward 20 ft. The top of the steel tower is at an elevation of 315 ft., 169 ft. above ground level.

On each side of the river rest piers are founded on 95-ft. piling. The anchor blocks are located about 400 ft. back of the rest piers and were made by driving steel sheeting 40 ft. long to grade after the excavation was completed. The sheeting was left in place after the concrete was poured to provide protection from the scour of the river and also to add to the stability of the pier. The anchor piers are 22 ft. by 57 ft. each requiring about 850 yards of concrete.

Although the main span of the bridge is 1600 ft., as mentioned, the bridge overall is 3200 ft. This includes 800-ft. loaded side spans on each side.

Wind arms extend 107 ft. from the center-line of the main towers. These weigh 18 tons each assembled on the ground and will be hoisted into place on the side of the column after the towers are erected.

The line pipe is supported on six main load cables, which are 2⅝ in. in diam. and 4020 ft. long. Each cable, together with socket connections, weighs approximately 21 tons. The two wind cables are 2¾ in. in diam. and 4026 ft. long. Each weighs approximately 26 tons. Side spans of 800 ft. are used incorporating 70-ft. high rest towers to support the main cables and wind cables.

The other water crossings are being constructed by the conventional method of making up the sections of pipe and either pushing or pulling into place as required. All river crossing lines including headers are coated with an asphalt-mastic type of coating. The Sabine River, and flats, 8300 ft. wide, consists of two 20-in. lines; Bayou Pierre, 500 ft. wide, of three 16-in. lines; Loggy Bayou, 570 ft. from header to header, three 16-in. lines; Bayou D'Arbonne, 850 ft. wide, three 16-in. lines, and Ouachita River, 1725 ft. wide, five 14-in. lines.

In the matter of river clamps, a departure is made from conventional practice. Inasmuch as it was not possible to obtain cast-iron clamps, reinforced concrete clamps are used. The weight of these clamps varies from 1900 lb. each for those used on 14-in. pipe to 2630-2780 lb. for the clamps used on 24-in. pipe, the difference in weight of the

W. H. Hitchcock, Jr., United engineer (left), shows where extra wrap of felt is applied under concrete clamp. *Right*—Coating with enamel and wrapping with transparent glass fiber mat.

MODERN CROSSING *over a treacherous river . . .*

by Pittsburgh · Des Moines

Photograph above shows construction of main pier of 3200-foot pipe line suspension bridge over the Red River.

UNITED GAS PIPE LINE COMPANY adopted the modern method of crossing the Red River with their 24″ line running from the Carthage, Texas field to Sterlington, Louisiana and chose the Pittsburgh-Des Moines Steel Company to construct a 3200-fbot pipe line suspension bridge over the treacherous Red River near East Point, Louisiana.

A typical instance of Pittsburgh-Des Moines' ability to meet unusual construction requirements of the Petroleum and Natural Gas industry. ***Consult us on your current problem.***

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DALLAS, 1207 PRAETORIAN BUILDING · SAN FRANCISCO, 609 RIALTO BUILDING
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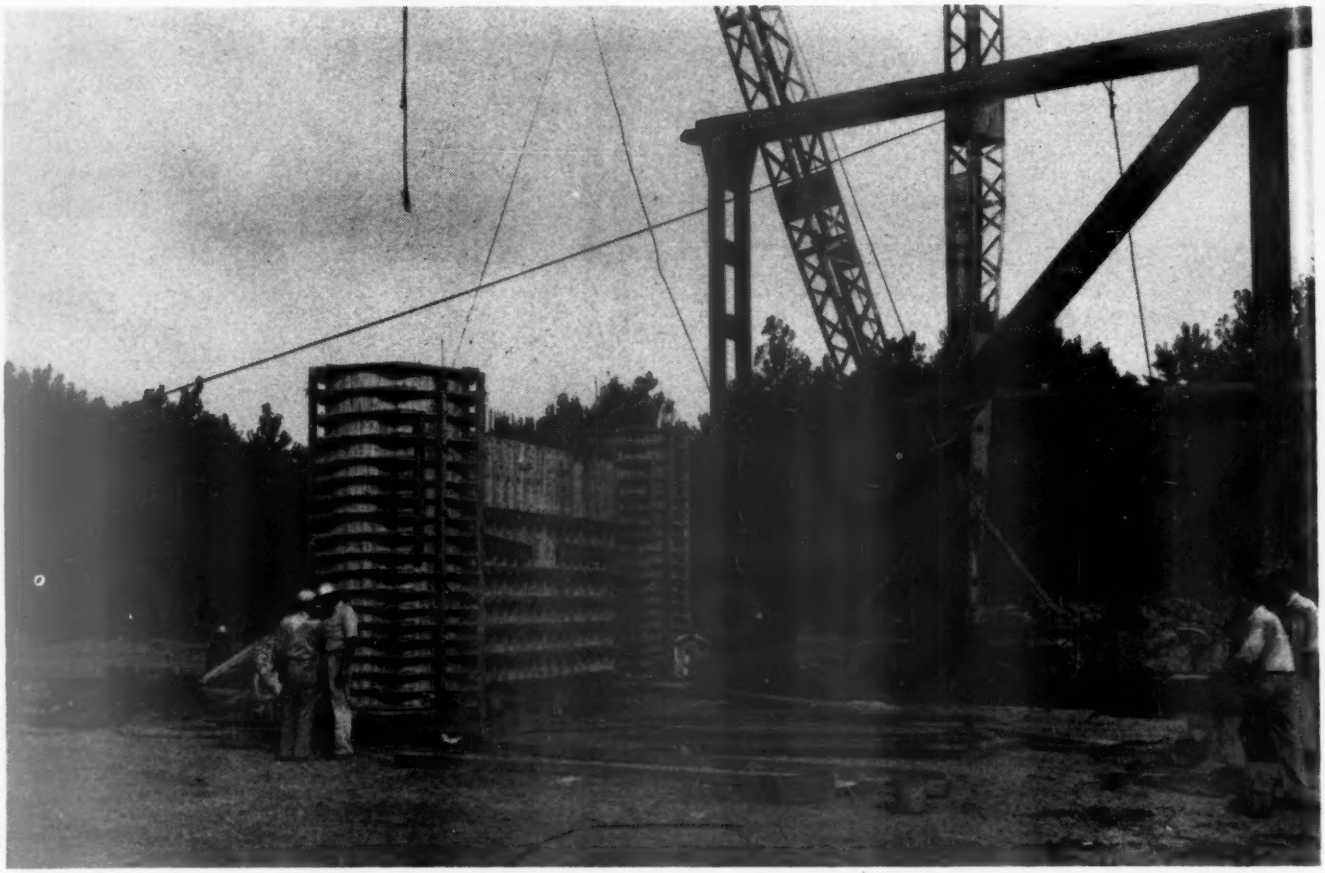


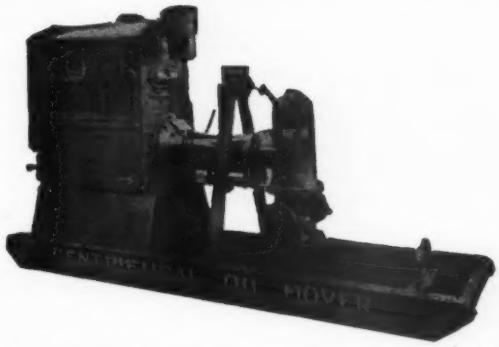
The Red River suspension bridge has a span between main piers of 1600 ft. and is designed to carry two 24-in. pipe lines. This construction scene shows the wooden forms still on the concrete cap on one of the main pier caissons, and part of the steel superstructure not yet erected.

***Below,* a workman removes a skid from beneath the 24-in. pipe as the traveling-type cleaning and priming machine moves along. Following at a short distance behind is the coating and wrapping machine.**

Portable Centrifugal Oil Movers

The answer for PORTABILITY

incorporating the advantages OF BOTH RECIPROCATING AND CENTRIFUGAL PUMPS



4" Model VTR Centrifugal Oil Mover set up for pumping

4" Model VTR Centrifugal Oil Mover with pump folded into skid base for portability and shipment.

The Centrifugal Oil Mover is a development by the Power Machinery Company in response to suggestions made to us by various members of the oil pipe line industry for a portable engine driven pumping unit which has the desirable features of both reciprocating and centrifugal pumps. This is our solution to this demand.

APPLICATIONS

1. Gathering Line Pumps.
2. Field Pumping Stations.
3. Gravity Line Boosters.
4. Tank Farm Transfer Service.
5. Tank Pump-out Units.
6. Main Line Station Suction Pumps.
7. Main Line Station Booster Pumps.
8. Loading Pumps for Tank Car Loading Racks.
9. Barge and Tanker Loading Pumps.
10. Barge Unloading Pumps.
11. Spill or Line-Break Recovery Units.
12. Water and other Fluids.

ADVANTAGES

1. Completely Portable.
2. Pump is Self-Priming.*
3. Pump will pull high vacuum against closed suction.*
4. Wide Capacity Range (See Capacity Table).
5. Capacity Range possible without change in Speed or Parts.
6. Discharge Pressure as high as 900 lbs. per sq. in. possible by operating as many as four or five units in series.
7. Gas-Gasoline Engine is conservatively loaded.

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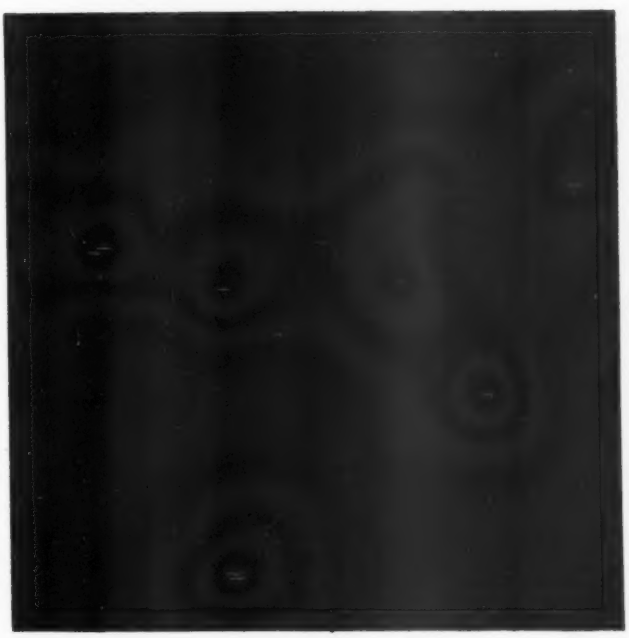

POWER MACHINERY COMPANY

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For Rotary Oil Movers see BULLETIN No. 100, 100-A and No. 101

clamp on the latter being governed by whether the pipe is coated with enamel or asphalt-mastic. In an accompanying illustration these concrete clamps are shown. When used, an extra wrap of asbestos felt is applied under the clamp to act as an additional guard against damaging coating during installation.

● **Welding procedure.** Stove-piping is the general procedure followed in lining up pipe for welding. The electric welding method is employed and five beads are run on each joint. After the tack welds are made, the following crew runs two stringer beads, and a third crew puts on the remaining three beads. All welds are stencilled with the welders initials and periodically coupons are cut and tested.

● **Coating and wrapping.** Except for river crossings and in certain swampy areas where asphalt-mastic is used, the line is being coated over its entire length with coal tar enamel. The asphalt-mastic is applied in central yards but the enamel is applied hot in the field in the conventional manner by traveling type machines that apply the wrapper at the same time. The asbestos felt used consists principally of several brands that have been in general use on pipe line work. On about one-seventh of the line, however, a newcomer has been introduced. This is a spiral wrap consisting of a thin porous mat of glass fibers that, together with the coal tar enamel, forms a continuous bond. The glass fibers are said to be non-corrosive to metal and the wrapper is purported to have a negligible moisture pickup. It is also asserted that its tensile strength is preserved through a wide range of temperatures and exposure to organic solvents and soil acids. When this type of wrap is used an outside spiral wrap of kraft paper is added.

All enamel coatings are being inspected by the Stearns electronic holiday detector. This equipment, developed by one of United's engineers, has been described in previous articles. Three of the detectors are in use, one on each spread.

● **Pipe bending.** Pipe bends are being made cold, employing a machine developed in recent years for bending large diameter pipe without the use of heat. Bending shoes can be interchanged to make a smooth bend or a wrinkle according to the wall thickness of the pipe. Smooth bends can be made on pipe of $\frac{3}{8}$-in. wall thickness, but on pipe of 9/32-in. wall wrinkle bends are made.

● **Main line valves.** Main line valves are being insulated from adjoining pipe so that each section of line between the valves will be isolated from the rest of the pipe insofar as flow of electrical current is concerned. This will permit the testing of each section of line separately to determine electrical resistance or condition of coating. Distance between main line valve settings is 5 to 7 miles.

● **Line pipe.** Weight and wall thickness of line pipe vary according to the pressures they will be subjected to in service. Seven weights of 24-in. pipe are being used, varying in wall thickness from $\frac{1}{4}$ in. to $\frac{1}{2}$ in., and in weight from 63.41 to 125.49 lb. per linear ft. The smaller diameter pipe used in water crossings has the following wall thicknesses and weights: 20-in. pipe, $\frac{1}{2}$-in. wall thickness and weight of 104.13 lb. per ft.; 16-in. pipe, $\frac{1}{2}$-in. wall and weight of 82.77 lb. per ft., and 14-in. pipe. $\frac{1}{2}$-in. wall and weight of 72.09 lb.

An interesting feature in the laying of the line is the use of anchors in areas subject to overflow. These anchor installations are being made at 75-ft. intervals in such locations. The saddle of the anchor, which fits the contour of the top part of the pipe, is made of 10-gage galvanized sheet steel die-formed to fit the contour of the outside surface of the coating. The pressed steel saddle is 18 in. wide and contacts the exterior of the coating for 26 in. thus forming a bearing area of about 470 sq. in., which reduces the unit bearing stress to a value such that no damage is done to the coating. Each side of the saddle has a $1\frac{1}{2}$-in. web that contains a $\frac{7}{8}$-in. diam. hole. The upper end of a 5-ft. rod, which is threaded at both ends, extends through the $\frac{7}{8}$-in. hole in the web and is fitted with a galvanized nut and washer. On the lower end of the rod are expanding metal lips. When the anchor is assembled the rods extend from the line pipe at an angle of 30 deg. with the vertical. A 6-in. hole is bored with a ground auger through the sides of the pipe line ditch near the bottom. Into these auger holes the rods are inserted with the lips folded against the rod. When in place,

A competent, experienced, well-equipped construction organization engaging in pipe line construction in all parts of the United States.

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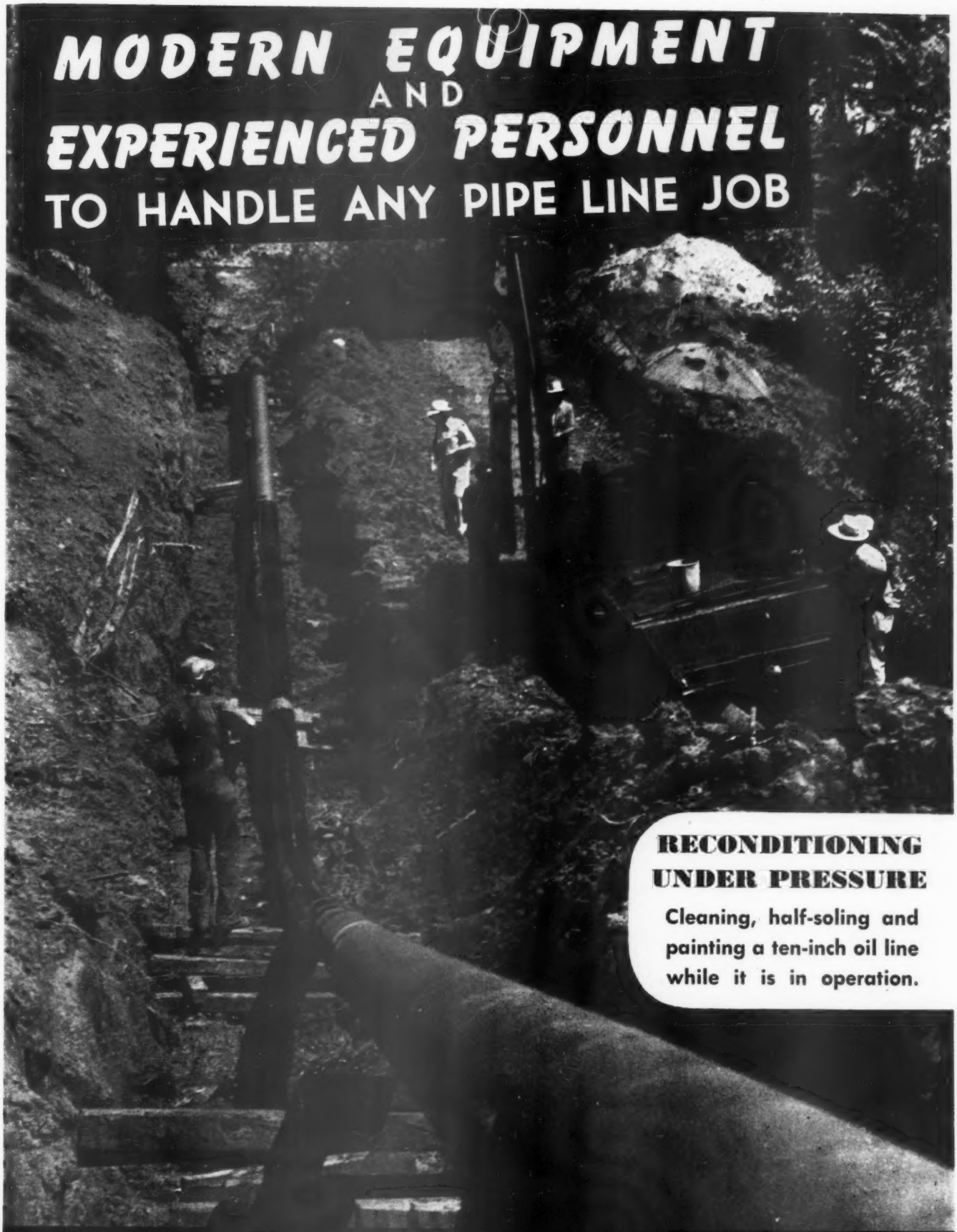

RECONDITIONING UNDER PRESSURE

Cleaning, half-soling and painting a ten-inch oil line while it is in operation.

RAY L. SMITH CONSTRUCTION COMPANY

PIPE LINE CONTRACTORS

HAZLETT BUILDING — EL DORADO, KANSAS

A welder completing a bead on the underside of the pipe. Welding was by the electric method and five beads were run on each joint.

The traveling-type machine shown below is coating the pipe with coal tar enamel and wrapping with asbestos felt, all in one operation.

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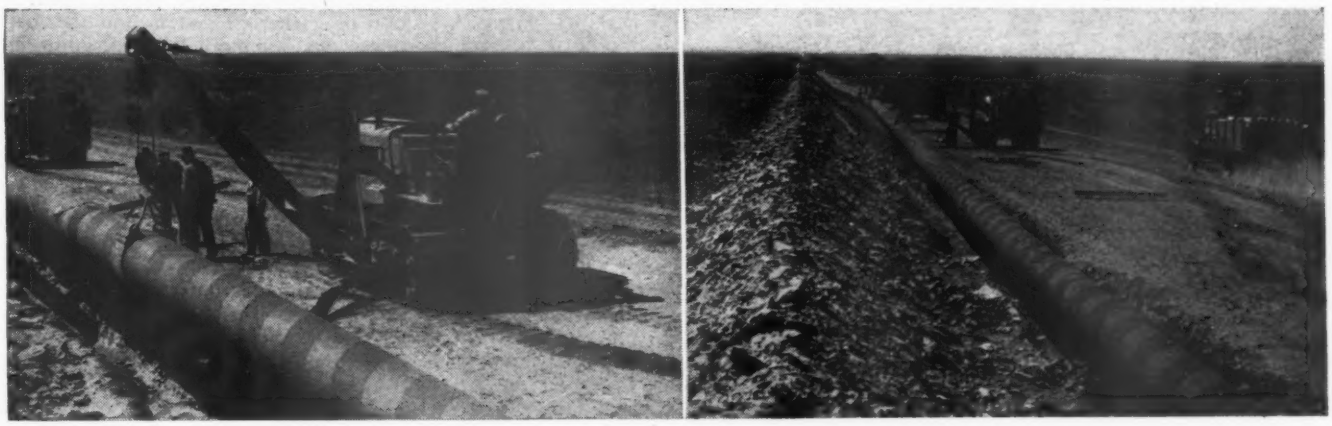
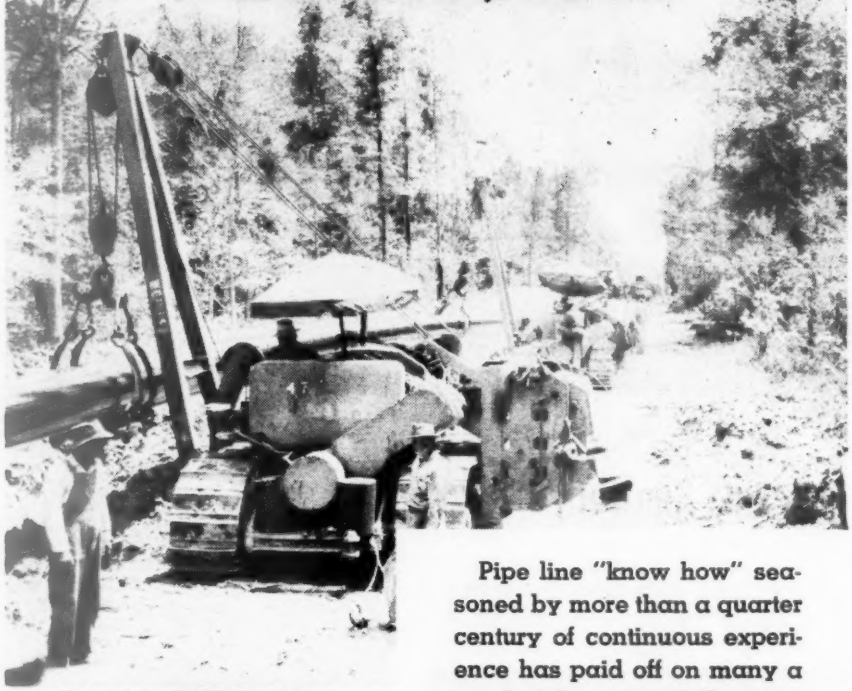


OVER 25 YEARS
Continuous Pipe Line EXPERIENCE



Pipe line "know how" seasoned by more than a quarter century of continuous experience has paid off on many a tough job successfully completed by O. C. Whitaker Co. crews.

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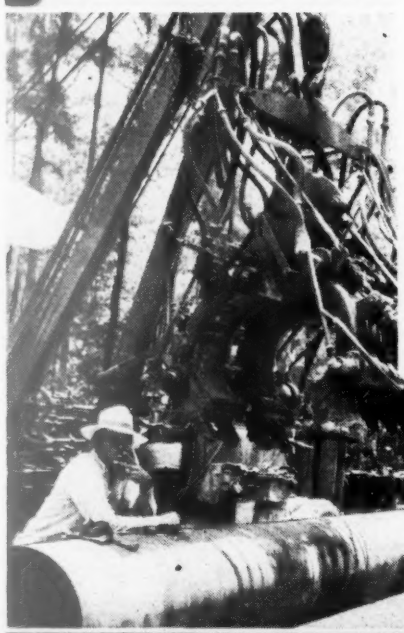

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the rod is rotated by means of a hand tool causing expansion of the lips against, and thence into, the walls of the hole, holding the anchor firmly in place to guard against flotation of the line. A strip of expansion joint material ½-in. thick is placed between the saddle and the coating surface further to insure even distribution of bearing stress under the saddle.

● **Protection from corrosion.** In plans for the line and in the methods adopted for its construction full thought was given to protection against corrosion. This fact is borne out by the several features that have been discussed in this article, namely: (1) Coating and wrapping of the line over its entire length; (2) thorough holiday inspection; (3) electrical isolation of line sections between main line valves, and (4) use of specially designed preformed saddles of large bearing area to prevent damage to the coating at anchor installations.

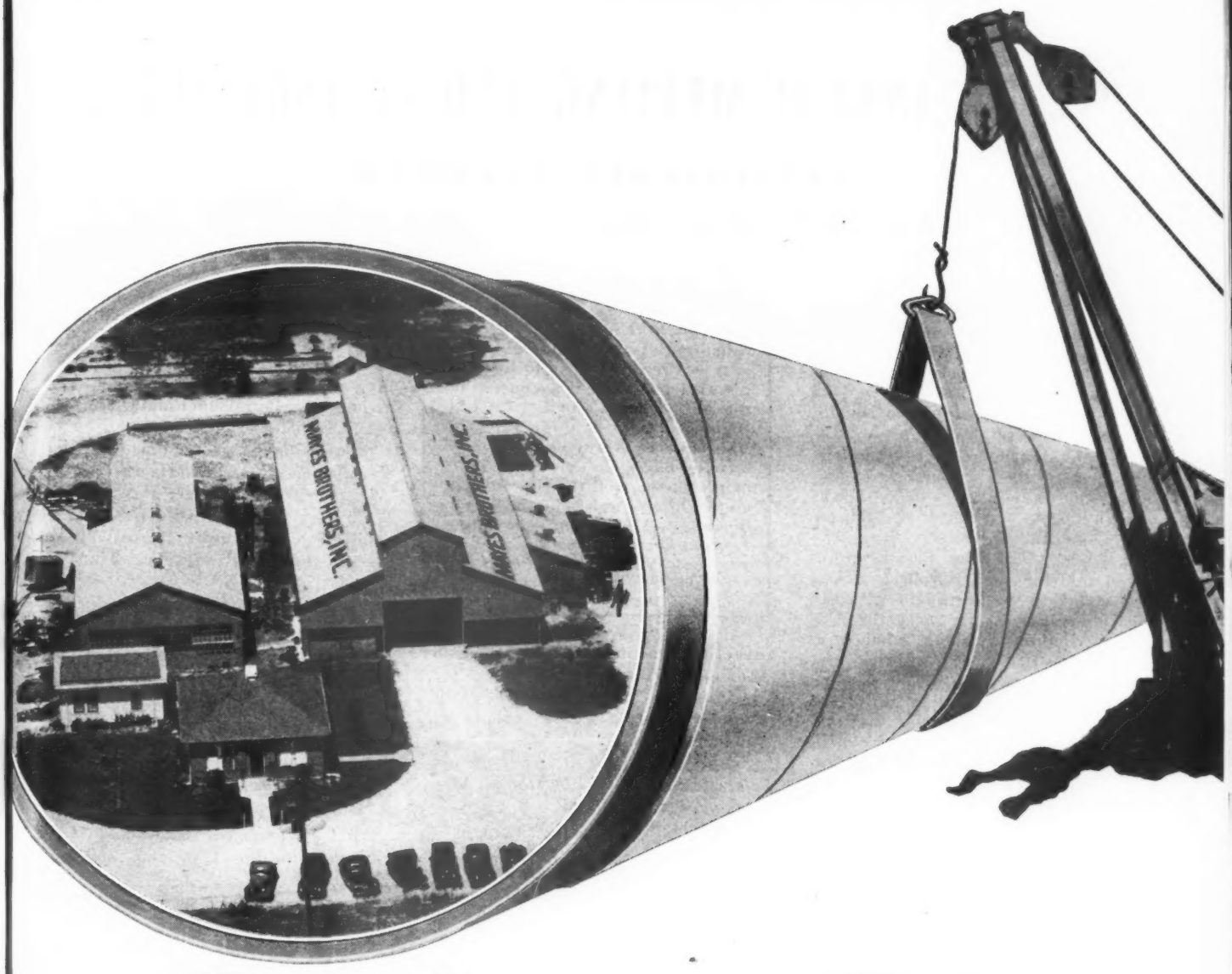
Supervising Personnel

Paul Williams is the engineer in charge of all well hook-up work in the field. C. W. Hollenshead is the engineer in charge of construction of the gasoline and dehydration plants in the Carthage field. V. E. Hamilton, Jr., is the engineer in charge of pipe line construction being assisted on the job sites by W. H. Hitchcock, Jr., A. H. McDonald, F. W. McCarthy, and R. A. Woodall. Carroll Smith, engineer, is in charge of the Red River bridge construction. The entire project is under the direct supervision of D. R. Pflug of the company's engineering department, assisted by D. E. Stearns and R. H. Feild.

All inspectors are regular company employes brought in from other locations on the company's properties for this construction project. Each of the three spreads has 5 inspectors, as follows: (1) Welding, (2) cleaning and priming, (3) coating, (4) lowering in, and (5) a general inspector who is qualified to perform any of these jobs. These 5 inspectors are under the supervision of a chief inspector. George Waverly is the chief inspector for all construction east of the Red River and W. H. Kearney is chief inspector west of Red River.

Contractors

The gasoline and dehydration plants are being constructed by Stone and Webster Engineering Corporation. The O. C. Whitaker Company of Fort Worth is the general contractor for construction of gathering system and the main line. This company laid the gathering system in the Carthage field and is laying 52 miles of the main line eastward from that field to the Red River. Subcontractors are O. E. Dempsey Construction Company, which is laying 40 miles of main line from a point south of Arcadia, Louisiana, westward to the Red River, and Associated Contractors and Engineers, which is laying 50 miles eastward from Dempsey's beginning point to the end of the line at United's Sterlington compressor station. The Pittsburgh-Des Moines Steel Company is constructing the suspension bridge over the Red River. ★ ★ ★



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Complete Re-conditioning Service For Old Pipe

API 25th ANNUAL MEETING AND VICTORY JUBILEE

PRELIMINARY PROGRAM

Stevens Hotel, Chicago, Illinois, November 12-15, 1945

THE Twenty-fifth Annual Meeting and Victory Jubilee of the American Petroleum Institute, the first annual meeting since the Institute's second war conference in November of 1943, will be held in the Stevens Hotel, Chicago, Illinois, November 12 to 15, 1945.

The program will feature nationally prominent speakers on subjects of particular interest to industry today such as new products, new markets, and enlarged opportunities for service.

Scheduled to speak are Petroleum Administrator for War Harold L. Ickes, who will discuss the Anglo-American Oil Agreement recently renegotiated in London; Deputy Petroleum Administrator Ralph K. Davies, who will report on the wind-up of the affairs of the wartime government-industry partnership of the Petroleum Administration for War and the Petroleum Industry War Council, both of which predicted and promised to close their doors with the surrender of the enemy; and William R. Boyd, Jr., of the Institute, who will discuss present and future aspects of the petroleum industry.

Also on the program are Lieutenant-General James H. Doolittle of the U. S. Army Air Corps; Lieutenant-General Raymond S. McLain of the U. S. Army; and Colonel Donald L. Putt, Deputy Commanding General, Intelligence (G-2), Air Technical Service Command at Wright Field, Ohio. An afternoon session will be addressed by Vice Admiral Ben Moreell, Chief of the Bureau of Yards and Docks and Officer in Charge of Navy Petroleum Plant Office, Washington, D. C., with associate officers.

Others scheduled to speak are Chairman of the Board C. R. Smith of American Airlines, Inc., who will discuss the future of aviation in relation to petroleum; Dr. Clark Goodman, atomic-bomb scientist at Massachusetts Institute of Technology, who will speak on "Petroleum Versus Plutonium"; Dr. Paul H. Giddens, historian, curator of the Drake Well Memorial Park, who will speak of the historical aspects of petroleum; and Dr. Virgil Jordan, president of the National Industrial Conference Board.

Scientists and practical operators in the petroleum industry will discuss the new technology of finding, producing, and refining crude oil, as well as the distribution of petroleum products. Other speakers will discuss gasoline quality, fuel-oil availability, and world supplies of gasoline, kerosine, and burning oils.

The Institute's board of directors will meet daily, Tuesday through Thursday, November 13-15, and the newly-elected executive committee will have a session Thursday.

Throughout the meeting some 90 Institute committees will meet daily and give their reports.

A trade-association conference on public relations will be held Monday afternoon, November 12.

Registration will open Monday morning, November 12, in the Foyer of the Grand Ball Room of the Stevens Hotel to register those attending the annual meeting, and will remain open until Thursday afternoon.

Following is the preliminary program:

> ***Important Note:*** **Attention is called to the special announcement sent by President Boyd to Institute members, October 12, concerning the critical hotel situation in Chicago. We trust that every person who expects to attend the annual meeting has *again* written the hotel of his choice, and that no one will go to Chicago unless he has a confirmation of his room reservation. *If you have not already written your hotel for confirmation of reservation, do it now!***

GENERAL SESSIONS

Wednesday, November 14

2:30 p. m. Grand Ballroom

Report of Board of Councillors and election of directors.

President's address—William R. Boyd, Jr., president, American Petroleum Institute; chairman, Petroleum Industry War Council.

Address—Ralph K. Davies, Deputy Petroleum Administrator for War.

Address—C. R. Smith, president, American Air Lines, Inc., New York.

Address—Dr. Virgil Jordan, president, National Industrial Conference Board.

8 p. m. Grand Ballroom

Address—Hon. Harold L. Ickes, Secretary of the Interior; Petroleum Administrator for War.

Address—Lt. General James A. Doolittle, U. S. Army Air Corps.

Address—Lt. General Raymond S. McLain, U. S. Army.

Thursday, November 15

2:30 p. m. Grand Ballroom

Address—Vice Admiral Ben Moreell, Chief of the Bureau of Yards and Docks and Officer in Charge of Navy Petroleum Plant Office, Washington, D. C.—with Captain B. W. Gillespie, Executive Officer, Navy Petroleum Plant Office, Washington, D. C., and Commander J. G. King, Navy Petroleum Plant Officer, Chicago, Illinois.

Petroleum vs. Plutonium—Dr. Clark Goodman, Massachusetts Institute of Technology, Cambridge, Mass.

History Looks at Oil—Dr. Paul H. Giddens, curator of the Drake Well Memorial Park and Museum, Titusville, Pennsylvania.

Address—Speaker to be announced.

GROUP SESSIONS

Wednesday, November 14

9:30 a. m. Division of Production (South Ballroom)

Well Spacing and Production Allocation—Sponsored by the Special Study Committee on Allocation of Production and Well Spacing.

Presiding: Edgar Kraus, The Atlantic Refining Company, Dallas, and H. H. Kaveler, Phillips Petroleum Company, Bartlesville.

Papers on the following subjects are now under consideration—Optimum Well Spacing; A Factual Analysis of the Effect of Well Spacing on Oil Recovery; A Re-examination of Production Data on Mexia-Powell Fault-Line Fields.

9:30 a. m. Division of Refining (Grand Ballroom)

Research and Technology — Presiding: Harry Levin, The Texas Company, Beacon, New York.

No Peace for Fractionators — P. J. Harrington, B. L. Bragg, III, and C. O. Rhys, Jr., Standard Oil Development Company, Elizabeth, New Jersey.

The Story of the Technical Oil Mission—A. E. Miller, Sinclair Refining Company, New York.

Investigation of European Synthetic Oil Industry—W. J. Schroeder, U. S. Bureau of Mines.

Address—Col. Donald L. Putt, Deputy Commanding General, Intelligence (G-2), Air Technical Service Command, Wright Field, Ohio.

Coordinating Research Council in the Days to Come—K. G. Mackenzie, The Texas Company, New York.

Thursday, November 15

9:30 a. m. Division of Production (South Ballroom)

Technology of Water Injection — (Sponsored by the Topical Committee

on Production Technology). Presiding: J. E. Sherborne, Union Oil Co. of California, Santa Fe Springs, California; and Paul D. Torrey, Houston, Texas.

Injection of Water into Underground Reservoirs in Michigan—W. E. Schoeneck, The Ohio Oil Co., Grand Rapids, Michigan.

Technology of Water Injection in the Allegany Field, New York—George W. Holbrook and Wilbur H. Young, Bradley Producing Corp., Wellsville, New York.

The Behavior of Water-Input Wells—Parke A. Dickey, Quaker State Oil Corp., Bradford, Pennsylvania, and Kurt H. Andresen, South Penn Oil Co., Bradford, Pennsylvania.

Pressure Maintenance, Midway Field, Arkansas (Tentative)—Speaker to be announced.

Report of Division's Nominating Committee—Carl E. Reistle, Jr., Humble Oil and Refining Co., Houston, Texas, chairman.

Election of Twenty Members of the General Committee of the Division of Production.

Thursday, November 15

9:30 a. m. Division of Refining (Grand Ballroom)

Catalytic Cracking—Presiding: H. W. Field, The Atlantic Refining Company, Philadelphia.

Liquid Charge Technique in TCC Cracking—T. P. Simpson, Socony-Vacuum Oil Company, and H. G. Shimp, Houdry Process Corporation of Pennsylvania, Marcus Hook, Pennsylvania.

Peace-time Fuel Oils From War Equipment—J. A. Bates, J. B. Hill, and Arthur E. Pew, Jr., Sun Oil Company.

High Capacity Operation of Fluid Cracking Units—E. V. Murphree, E. J. Gohr, H. Z. Martin, H. J. Ogorzaly, and C. W. Tyson, Standard Oil Development Company, Elizabeth, New Jersey.

Report of Division's Nominating Committee—T. G. Delbridge, The Atlantic Refining Company, Philadelphia, chairman.

Election of twenty members of the General Committee of the Division of Refining.

Thursday, November 15

9:30 a. m. Division of Marketing (North Ballroom)

Marketing session—Presiding: E. V. Weber, Eureka Oil Company, Cincinnati, Ohio.

Papers on the following subjects are now under consideration by the Program Committee, speakers to be announced later — Gasoline Availability; Fuel Oil Availability; World Supplies of Gasoline, Kerosine, and Burning Oils.

Report of Division's Nominating Committee: W. C. Burns, Richfield Oil Corporation of New York, chairman.

Election of twenty members of the General Committee of the Division of Marketing. ★ ★ ★

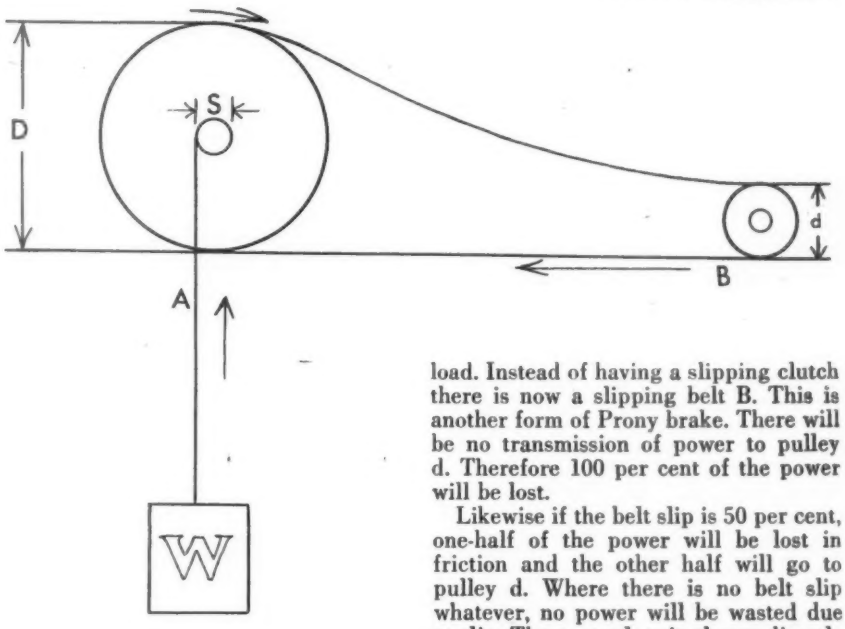
P 094.6

FIVE PER CENT BELT SLIP MEANS EQUAL POWER LOSS

By **W. F. Schaphorst**

MANY belt users still doubt that each per cent of belt slip causes one per cent loss of power. This writer has been asked for proof so often that he has now decided to put the proof in print and make the explanation as clear as possible.

This sketch shows a combination hoisting engine and belt drive. First, forget about the belt and consider only the weight W, which is being lifted by cable A around shaft S. If the weight is 33,000 lb., and if the hoist lifts that weight one foot in one minute it does the work of one horsepower. Now if the shaft is equipped with a clutch so adjusted that after the weight is lifted a few feet the clutch is allowed to slip in such a way that the weight is suspended in mid-air, so that it does not move upward or downward while the engine is running at normal speed, it is evident that the weight is being held there by the friction of the clutch. If there were no friction the weight would fall. Tension in cable A is 33,000 lb. Therefore the engine is doing work even though the weight does not move a thousandth of an inch. In fact, it is obvious that the engine is doing just as much work as it would be doing if the weight were moving upward at the rate of one foot per minute. If this is not fully clear the writer suggests that the reader study the principles of the Prony brake, available in many engineering text books and handbooks. A Prony brake does not move at all, the scales do not move, and in this illustration the weight W does not move when slip is 100 per cent.



Now forget about the weight and let us convert the engine over to belt drive. The belt on pulley D drives the smaller pulley d, the direction of motion of the engine, speed, power, and everything else being the same as before except that weight W is detached. If the belt does not move at all, and if the tensions in the belt are the same as when pulling full load, it is clear that the engine will be dissipating energy at the same rate at which it is spent when pulling full load. Instead of having a slipping clutch there is now a slipping belt B. This is another form of Prony brake. There will be no transmission of power to pulley d. Therefore 100 per cent of the power will be lost.

Likewise if the belt slip is 50 per cent, one-half of the power will be lost in friction and the other half will go to pulley d. Where there is no belt slip whatever, no power will be wasted due to slip. The power loss is always directly proportional to the belt slip. Thus if the belt slip is 1 per cent the power loss is 1 per cent. If the belt slip is 2 per cent the power loss is 2 per cent. If the belt slip is 100 per cent the power loss is 100 per cent.

Belt slip on important drives is expensive not only in the cost of wasted fuel but also in the cost of the rapidly wearing out belts and the lessened production. Production loss, similar to power loss, is often directly proportional to belt slip. ★ ★ ★

Some new officers of Oilwell Drilling Contractors: William T. Payne, president; J. E. Warren, George P. Livermore, F. L. Carmichael, and H. C. Milhoan, vice presidents.

DRILLING CONTRACTORS MEET

More than 600 persons attended the fifth annual meeting of the American Association of Oilwell Drilling Contractors, which was held at the Skirvin Hotel on October 1 and 2 in Oklahoma City. Registration was greatly in excess of that of any prior year, dut partially to last-minute lifting of ODT restrictions.

On Monday, October 1, the morning was devoted to open committee sessions. So great was the response to the call of committee chairmen that the capacity of most meeting rooms was taxed. Meetings were held by the committees on manpower and labor relations, insurance and safety, accounting, rotary drilling and cable tool drilling.

The first general session convened on Monday afternoon under the direction of Dr. Waldo Stephens, of Oklahoma City. The address of welcome was given by Dr. John R. Abernathy, of Oklahoma City. The retiring president of the association, Howard P. Holmes of Dallas summarized the year's accomplishments and emphasized the seriousness of adjusting operations to a peacetime basis. Reports of standing committees and the committee on nominations were also presented at this session.

Following the afternoon meeting, the newly selected board of directors held an organization meeting, for the purpose of choosing officers and outlining a work program. Monday evening activities included a fellowship hour and banquet which was held in the Silver Glade of Skirvin Tower. Robert S. Kerr, governor of the State of Oklahoma, served as toastmaster, and Dr. George L. Cross, president of the University of Oklahoma, addressed the members on the importance of encouraging pure as well as applied scientific research.

The Tuesday morning session, October 2, was led by Ralph W. Marshall, of Los Angeles. Douglas Ragland, chief engineer of Humble Oil and Refining Company, Houston, Texas, presented a paper on "Drilling Equipment Needs." A paper entitled "Trends of Taxation," was read by J. A. Phillips, of Houston, Texas. The accounting program of the association was discussed by Leland Breckenridge, member of the A.A.O.D.C. staff. The final paper of the morning was given by W. F. Burris, Phillips Petroleum Company, Bartlesville, Oklahoma, on "Safety in Drilling."

The convention moved immediately into its final business session under the direction of C. W. Alcorn, of Houston, Texas. P. H. Bohart, director of production, PAW, Washington, D. C., presented a paper entitled "The Petroleum Outlook". Glenn A. Campbell, Tulsa, gave a paper on "Adaptation of Contract Drilling to Peacetime Operations," and N. A. Endicott read a paper by Fred M. Mayer, Dallas, on "Equipment Delivery Prospects."

The Oklahoma City committees on arrangements and entertainment rounded out the convention program Tuesday evening with a barbecue at the Oklahoma City Country Club.

Names of the newly elected officers and directors are as follows:

Officers:

William T. Payne, Oklahoma City, Oklahoma, president.
J. E. Warren, Midland, Texas, vice president at large.
George P. Livermore, Lubbock, Texas, vice president for West Texas and New Mexico.
James D. Leonard, Mount Pleasant, Michigan, vice president, cable tools.
C. W. Alcorn, Houston, Texas, vice president for Gulf Coast.
H. C. Milhoan, Tulsa, Oklahoma, vice president for Central Mid-Continent and Rocky Mountains.
A. S. Hayes, Los Angeles, California, vice president for California.
F. L. Carmichael, Evansville, Indiana, vice president for Illinois, Michigan, Indiana and Kentucky.
J. K. Butler, Houston, Texas, vice president for well servicing.
Harry W. Bass, Dallas, Texas, treasurer.
Brad Mills, Dallas, executive secretary.

Directors at large:

A. H. Rowan, Fort Worth, Texas.
H. L. Sullivan, Tulsa, Oklahoma.
J. E. Warren, Midland, Texas.
John A. Chapman, Houston, Texas.
K. B. Knox, Houston, Texas.
Harry W. Bass, Dallas, Texas.
Howard P. Holmes, Dallas, Texas.
J. E. Brantly, Dallas, Texas.
George F. McQueen, Fort Worth, Texas.
Joe S. Morris, San Antonio, Texas.
C. J. Paine, Dallas, Texas.
William T. Payne, Oklahoma City.
H. E. Hamilton, Houston, Texas.
Gifford C. Parker, Tulsa, Oklahoma.
Jack W. Frazier, Houston, Texas.
George P. Livermore, Lubbock, Texas.
F. L. Carmichael, Evansville, Indiana.
J. K. Butler, Houston, Texas.
N. H. Wheless, Shreveport, Louisiana.
Glenn A. Campbell, Tulsa, Oklahoma.
Warren S. Churchill, Tulsa, Oklahoma.
H. C. Milhoan, Tulsa, Oklahoma.
Travis M. Kerr, Oklahoma City.
C. W. Alcorn, Houston, Texas.
James D. Leonard, Mount Pleasant.
A. S. Hayes, Los Angeles, California.

Regional directors:

Pacific Coast region: E. C. Brown, Long Beach; Karl L. Kellogg, Long Beach; Thomas P. Pike, Los Angeles; Thomas M. Rowan, Long Beach; Ralph W. Marshall, Los Angeles.

North Central Texas: Wm. D. McBee, Dallas; J. J. Moran, Wichita Falls; M. W. Blair, Wichita Falls.

Cretaceous and Tertiary basins: James R. Nowery, Shreveport; J. Zeppa, Tyler; J. I. Roberts, Shreveport.

North Central Paleozoic Basin: Walter G. Tschudin, Mt. Vernon, Illinois; Will I. Lewis, Mt. Vernon; A. F. Keating, Tulsa.

Permian Basin: C. J. Davidson, Fort Worth; Guy Mabee, Midland; C. M. Ashby, Dallas.

Central Mid-Continent Basin: Harry S. Connelly, Wichita, Kansas; George Lang, Tulsa; Frank M. Porter, Oklahoma City.

Gulf Coast region: Al A. Buchanan, San Antonio; E. J. Nicklos, Houston; H. C. Fitzpatrick, Corpus Christi.

Appalachian region: Wallace H. Haupt, Greensburg, Pennsylvania; Arland Fox, Washington, Pa. ★ ★ ★

Babe Doyle, Hydril; Tut Lee, Ideco; Jerry Engstrand, Grant Oil Tools, and Ted Forsyth.

LOS ANGELES NOMADS LEARN MORE ABOUT JET PROPULSION

With that well known oratorical smoothie, Hi Cassidy, holding forth as deputy for Prexy Elmer Smith, now hobnobbing in South America, the Los Angeles chapter of Nomads held another very successful get-together on Wednesday, September 12, at the Mayfair Hotel.

About 75 were present for the doings, among them several gentlemen from far distant parts, notably F. R. "Nate" Groenke of Socony-Vacuum, Caracas, Venezuela, who is vacationing briefly in the Angel City. Nate gave a good account of himself during the evening, first with a description of how the New York chapter conducts itself, and later with a dramatic recital of an English sports event, delivered in the vernacular and with gestures. Both were well received, and Nate was allowed to remain.

Other visiting guests from away off were the La Mar boys, Hobart and Charlie. Hobart was drilling superintendent for New Zealand Petroleum Company, came back from down under

Relaxing after the ordeal of initiation are the new members above: Bill Kinder, Emsco D + B; Best Dawson, Oil Well Manufacturing Company; Lee J. Laird, Chiksan. Right are Earl Boggess, Baker Oil Tools, and F. R. Groenke, Socony-Vacuum, Caracas, Venezuela. Looks as if Nate had just told Earl a good one.

Across bottom of page are Charles LaMar, drilling supervisor for Barnsdall South American Corporation in eastern Venezuela, Hobart LaMar, former drilling superintendent for New Zealand Petroleum Company; Calvin Drake, Hydril; Bill Heater, Baroid, and John F. Herold, Baroid.

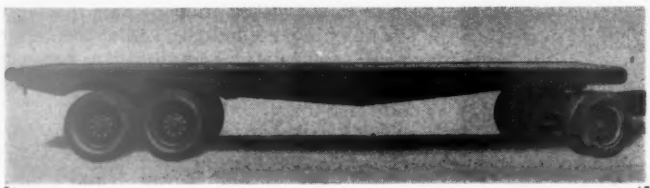
Just listening in are Norman Dorn, Lane-Wells; Elmer Decker, Martin Decker; and two of his aides, D. Linden and Jack Marsh.

about the middle of January, and it is rumored will soon be back in harness again as drilling superintendent for Phillips Petroleum Company. Charlie, drilling supervisor for Barnsdall South American Corporation in eastern Venezuela, is here vacationing at his home in Long Beach, California. He returns to Venezuela in November.

First order of business after dinner was the induction of six new members, who before receiving their diplomas were subjected to a regular F.B.I. inquisition by Ted Forsyth. Ted must have employed Walter Winchell to do some keyhole peeking for him on these lads, for he certainly had some astonishingly intimate details of their respective, but not altogether respectable, adventures. However, they all managed to look the inquisitor in the eye without quailing and were finally admitted to the fold by Chairman Cassidy. The initiates were Bill Kinder, Emsco D+B; Best Dawson, Oil Well Manufacturing Company; Lee Laird, Chiksan; Babe Doyle, Hydril; Tut Lee, Ideco, and Jerry Engstrand, Grant Oil Tools.

The speaker of the evening was Charles Cosser, General Electric application engineer, who knows more about jet propulsion than jet himself. He described interestingly the various steps in the development of high speed aviation, and gave some amusing highlights on experience to date. How an English tommy had a cup of tea whisked off a saucer into the air duct on a jet propelled ship was one story that ended in disaster for the engine and education for the tommy. Another involved the whisking of a dress from the chassis of a nearby WAAC, ruining at one fell swoop the engine and the young lady's modesty. These were merely sidelights, however, on a very informative technical presentation that created lots of interest and promoted a veritable barrage of questions. Cosser brought with him a quartet of instrumentalists and singers from General Motors Corporation, the Melody Men. They dispensed tuneful music liberally and in pleasing style and received a well deserved ovation when they had finished their contribution.

The meeting closed with a colored movie of Mexico, taken and presented by Charles Schultz of Southern Pacific Company. This was an exceptionally fine picture that kept the boys glued to their seats until closing time, and rounded out a well balanced and well conducted program. ★ ★ ★



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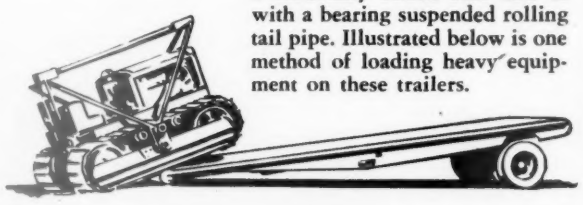
Nabors self-loading Platform Trailers, both single and tandem axle models, are designed expressly for heavy machinery and equipment hauling. Equipped with rolled front end with built-in lift hook and may be supplied with either a stationary rolled rear end or with a bearing suspended rolling tail pipe. Illustrated below is one method of loading heavy equipment on these trailers.



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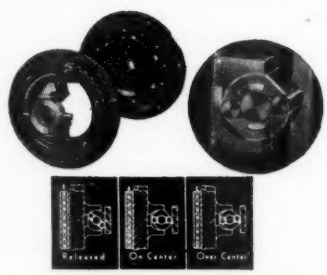

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ROCKFORD CLUTCHES

DIGEST OF CHEMICAL SOCIETY PAPERS

Freed from wartime tasks, scientists in the laboratories of industry are making available reports of research that promise useful application in the peacetime economy. More than 100 papers disclosing the results of scientific investigations have been submitted to a "Meeting-in-Print," a symposium of the American Chemical Society arranged in lieu of the Society's 1945 national meetings, cancelled because of restrictions on the holding of conventions.

Advances in petroleum chemistry are reported to the Society's Division of Petroleum Chemistry. New processes and new techniques promising further advantages in the production and uses of fuel are described in a score of papers by oil chemists.

C. L. Brown, Alexis Voorhies, Jr., and W. M. Smith of the Louisiana division of Esso Laboratories, Standard Oil Company of New Jersey, discuss the pilot plant development of a combination hydrogenation-and-catalytic cracking process. As an illustration of the potentialities of the combination process, it was calculated that an overall volumetric yield of more than 90 per cent of 100-octane number gasoline might be obtained from a typical petroleum feed stock.

"Although this adaptation of hydrogenation has not yet been commercially applied, it is deserving of thoughtful study as a means of conserving petroleum supplies from the standpoint of national policy," it is pointed out by the authors in a paper entitled "Hydrogenation and Desulfurization of Cycle Stocks from Catalytic Cracking."

For the first time, a set of molecular weight correlation charts, which cover the whole range of petroleum products, is presented. The charts are the work of I. W. Mills, A. E. Hirschler, and S. S. Kurtz, Jr., of the Sun Oil Company, Norwood, Pennsylvania, who outlined a method of obtaining molecular weights that eliminates the necessity for carrying out experimental measurements.

The molecules of gasoline and oil are infinitestimal in size. It is part of the petroleum chemist's job to be able to determine the weight of these tiny molecules and determine it accurately. For every gallon of gasoline used, at least 15 million, million, million, million molecules of hydrocarbon are burned up. For every gallon of oil consumed, at least 4 or 5 million, million, million, million molecules of hydrocarbon have been used.

By the use of the charts, molecular weights can be determined with an accuracy that in most cases is as good as could be expected even if very careful experimental determination were made. As the necessary experimental data are usually obtained in the course of routine testing, the molecular weight itself can be obtained with almost no additional expense.

Development of an apparatus measuring the size of the pores in the catalyst materials used in the cracking of oil molecules into gasoline is reported by L. C. Drake and H. L. Ritter of the research and development division, Socony-Vacuum Oil Company, Paulsboro, New Jersey. Improved catalysts are promised.

The cracking catalysts used now and during the war to turn out high octane gasoline are porous materials, among the most porous known, it is explained. The pores in one small fragment $\frac{1}{8}$ in. in diam. are so extensive that if the pore surface could be opened out into a single plane, there would be as much surface as there is wall, ceiling, and floor-space in the average room in a dwelling house.

There exist suitable means for measuring this total surface. There exist also suitable means for measuring this total pore volume. From the two, making certain assumptions about the pore shape, it is possible to calculate an average pore size for the whole porous body. A typical average pore size for a typical cracking catalyst may be about one-fifth of a millionth of an inch.

This is just an average, and an average is not enough. The pores are actually in the same size range as the oil molecules to be cracked into gasoline. It is not unreasonable to expect that some pores are so small that the larger oil molecules cannot enter. These smaller pores are therefore ineffective for cracking even though the average size may be quite large enough. Measuring the actual pore sizes will therefore determine how much of the catalyst will be operative, and will point the way to improved catalysts by indicating the inoperative part that should be removed.

The method itself involves an electrical measurement of the amount of mercury absorbed by the porous material when subjected to various pressures. It is then possible to calculate mathematically how much pore volume is associated with each different size pore; in scientific language, to determine a pore size distribution function. The method serves to show large differences in materials that by other measurements appear to be very similar.

A paper by Oliver Grummitt and E. N. Case, Sherwin-Williams Company, Chicago, Illinois, and C. V. Mitchell, U. S. Navy, Western Reserve University, Cleveland, Ohio, describes a type of catalytic cracking process by which hydrocarbon molecules whose properties as a gasoline are mediocre can be split so as to yield isobutane, a major raw material for the alkylation process. The catalyst for this process is aluminum chloride plus metallic aluminum or a similar metal.

Aluminum chloride, which is made either from metallic aluminum plus chlorine or from the mineral bauxite with coke and chlorine, has long been known as a catalyst, both in organic chemistry and in petroleum technology. The presence of aluminum serves to moderate the rather drastic activity of the aluminum chloride and adds to the flexibility of the process in terms of isobutane production and a by-product light naphtha, which would be used as an aviation blending stock.

The potential value of this process will depend upon several factors, such as the quantities of high-test gasoline required during peacetime, the relative cost of isobutane as compared with other processes, and the quality of automotive fuels. These factors make it impossible at present to predict future use in a peacetime economy. In any event, this process represents an advance in the techniques that the petroleum industry has for production of high-grade gasoline.

It is somewhat surprising to find that some of the constituents of aviation gasoline, instead of just having one melting point, may have two or three, or perhaps even more melting points and that these may differ for the same compound by more than 14°F., says a report from A. E. Hirschler and W. B. M. Faulconer of Sun Oil Company, Norwood, Pennsylvania.

The group of compounds known as the C_9 alkylbenzenes, which have these unusual characteristics, have been investigated by Hirschler and Faulconer, and their results are reported in a paper entitled, "Freezing Points of the Nine Carbon Alkylbenzenes."

The C_9 alkylbenzenes are compounds that contain one benzene ring in each molecule and have three carbon atoms attached to this ring in various ways. The difference in the manner of attachment of these three carbon atoms makes a very great difference in the freezing and melting characteristics of the individual compounds. There are eight ways in which these three carbon atoms can be attached, and consequently eight different compounds in this group. All have been studied and six have been shown to have more than one freezing point.

These compounds all freeze at rather low temperatures, the highest at 13°F. below zero, and the lowest 150°F. below zero. The lower temperatures are attained by using liquid air as the refrigerant.

★ ★ ★

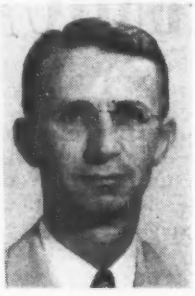
Organization changes

Two interesting organization changes announced by Union Oil Company of California are the election of R. D. Gibbs to a vice presidency, and the appointment of Ted Miles as manager of foreign operations.

Ronald Gibbs, familiarly known as "Frick" to his friends is a long term Union employe. He was for a number of years manager of the company's gas operations, was later in charge of all domestic field operations, and just prior to his most recent promotion was assistant to executive vice president, W. L. Stewart, Jr.

Frick is a past president of the California Natural Gasoline Association and is still very active in association affairs as a member of the board of directors. He is unusually adept at sports and has won many trophies for his prowess in golf and tennis. In fact, one of the big moments in his exciting career came when he tried to do a welding job on a CNGA golf cup that he had just won some years ago. It was an ancient and much prized vessel, carrying the names of prior winners away back into the dim history of natural gasoline and golf. When, under the application of heat, it suddenly melted and ran under the stove, the feelings of the champ can be well imagined. In due course, however, he managed to locate a duplicate, and what it cost to have all the history once more engraved on its sides still makes him shudder every time he thinks about it.

R. D. Gibbs



Ted Miles

Ted Miles who now directs Union's foreign development work was just recently Commander Miles of the United States Naval Reserve. Despite his youthful appearance he is a veteran of two wars. Beginning in April, 1942, his latest military adventure started him off as a member of the Shore Establishments Division of the Navy at Washington, D. C., whence, after 16 months, he was transferred to the Planning Division of the Army and Navy Petroleum Board, in charge of production. Through a succession of elevations he eventually became executive officer of the Planning Division, in which capacity he remained until his discharge in July, 1945.

Also a long term employe of Union Oil Company, Ted Miles has occupied some highly responsible posts, including that of general field superintendent. He has had considerable experience in foreign fields and being both observing and erudite is an exceedingly interesting and lucid conversationalist. A keen sense of humor also adds substantially to his entertainment value—and a trip over the properties of the Union Oil Company with Ted as host is not only educational but thoroughly worthwhile in many respects.

Open branch

Harry E. Clark and Company, Houston, Texas, distributor for Strong, Carlisle and Hammond steam specialties, opened a sales and service branch in Dallas, telephone Lakeside 4111.

Henry L. Litchfield, until recently a captain in the AAF, is in charge of the office. Litchfield has just returned from spending some time at the Strong, Carlisle and Hammond headquarters in Cleveland and at their manufacturing plant where he studied thoroughly the Strong line of open and inverted bucket traps, strainers, and pressure regulators and their proper applications.

A full line of Strong steam specialties will be carried in stock at the Dallas branch.

District manager

Tom C. Hendricks has been appointed district manager for Republic Supply Company in the Wichita Falls area, succeeding Frank M. Hedges who died October 5. Hendricks started with Republic back in the Ranger boom. He leaves the post of assistant district manager at Kilgore to assume his new duties.

HAMER PLUG VALVES

3" 6000 Lb. Test Christmas Tree Flow-Bean Plug Valve, flanged type.

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CHRISTMAS TREE
FLOW-BEAN PLUG VALVES

Combining in one unit: (1) a pressure-balanced plug valve which will never stick; (2) a geared head for easy operation; (3) an easily inspected, quickly changed flow-bean. Provides complete leak-proof shut-off while bean is being inspected or replaced—a matter of two minutes or less. The exclusive Hamer plug-adjusting nut assures easy, positive operation under all pressures and conditions.

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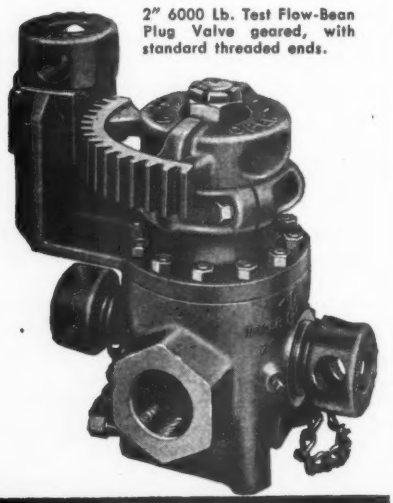
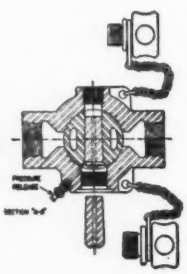


Note in section A-A the manner in which the bean is inspected or replaced.



HAMER

Research does things to JoneSuckeRods

Industry either advances or it falls. There is no stationary period in sucker rod development. Vigilance is the best defense; the road to progress. Combining science, engineering, field experience and manufacturing skill with laboratory and field tests, Jones Research is constantly on the alert for better material, better methods of processing, better handling and better customer service.

Knowledge of YOUR individual production problems obtained through constant field contact by Jones Field Engineers, is passed on to the Jones Research Department, whose broad experience, modern equipment and past achievements will enable them to continue to develop sucker rods for Maximum Service at Minimum Cost.

Jones superiority begins in the Jones laboratory, where everything from raw materials to finished products are subjected to detail and exhaustive study. By scientific methods and processes Jones has maintained its leadership through a long string of "firsts" in sucker rod supremacy. This modern Laboratory is the Heart of Jones Research.

Other JoneSuckeRod Famous Features

- LABORATORY TESTING
- FORGING
- NORMALIZING
- SURFACING
- THREADING
- PAINTING
- INSPECTION
- CARE AND HANDLING
- FIELD ENGINEERING

Write for Jones Book

This is the tenth of a series of ads discussing the many important factors that "do things" to JoneSuckeRods as discussed in the new Jones Book.

If you have not received YOUR copy of the new JoneSuckeRod Book, write our Tulsa office today.

The S. M. Jones Co.

JoneSuckeRods

General Office and Factory: Toledo, Ohio Sales Office: McBirney Bldg., Tulsa, Okla.
Export Office: 21 West St., New York, N. Y.

New officers of Oil Center Tool

Reading from left to right: J. E. Eckel, vice president in charge of engineering; J. E. Edwards, vice president in charge of sales; Fritz Richards, vice president and plant manager; B. V. Fisher, secretary-treasurer; Robert L. Tilly, president and general manager, and Arthur J. Penick, chairman of the board.

At a meeting of the board of directors of Oil Center Tool Company of Houston, manufacturers of oil well drilling control and completion equipment, A. J. Penick, president and general manager, was elected chairman of the board.

Robert L. Tilly, who has been associated with the First National Bank of Houston since 1933, was elected president and general manager. Tilly had been on leave from the First National to serve with the armed forces, receiving his discharge in June after 39 months with the U. S. Army Air Corps in the Continental United States and the Southwest Pacific. He held the commission of captain. Prior to his employment with the bank, Tilly attended the United States Military Academy at West Point and the Columbia University School of Business Administration.

J. E. Eckel, widely known in the petroleum engineering field, was appointed vice president and will assume active supervision of the company's engineering department. Eckel began his career in the oil business in 1929 as a student petroleum engineer with Humble Oil and Refining Company immediately after graduating from the University of Oklahoma with a B. S. degree in petroleum engineering. In 1944 he was promoted to senior engineer of Humble's petroleum engineering department and shortly thereafter became division equipment engineer, Gulf Coast division, in which position he devoted his entire time to investigation of the design and field application of drilling and production equipment. His resignation from the Humble company becomes effective October 15 and he will assume his new duties at Oil Center Tool Company on November 1. Eckel is a member of the American Institute of Mining and Metallurgical Engineers, American Petroleum Institute, and Texas Society of Professional Engineers.

J. E. Edwards, a member of the Oil Center sales department for 8 years and sales manager for the past year, was elected vice president in charge of sales.

Fritz Richards was reelected vice president and plant manager, and B. V. Fisher was reelected to his position of secretary-treasurer.

A. J. Penick, chairman of the board of directors, founded the company in 1927 with his late brother, K. T. Penick. Penick, who is widely known throughout the industry as a pioneer designer and manufacturer of numerous oil-well drilling and production tools, will divide his time between direction of his company's activities and the development of new and improved equipment.

Heads Monsanto

William McNear Rand has been elected president of Monsanto Chemical Company, St. Louis, Missouri, succeeding Charles Belknap, who will continue with the company as chairman of its executive committee. Rand, a vice president, assumed his new office October 1.

In announcing Rand's election, Board Chairman Edgar M. Queeny said that Belknap agreed to extend his service beyond the normal retirement date as executive committee chairman and

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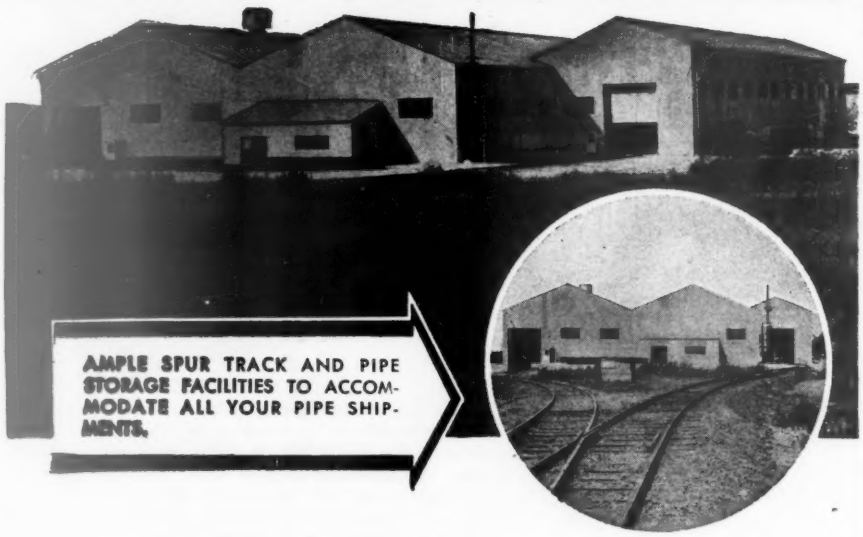
A MODERN PIPE PROTECTION PLANT—LATEST PRECISION DESIGNED EQUIPMENT...



Hill-Hubbell has built this additional plant to simplify your future corrosion problems. Unstintedly we have acquired every device in our 60,000 sq. ft. of enclosed floor space to further a precision application of steel pipe protection, unexposed to weather conditions.

Our modern plants are located with or in close proximity to leading steel pipe producing mills.

Hill-Hubbell process of coating and wrapping steel pipe is economical, insures satisfactory installations over other methods plus prompt delivery.

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HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE: SAN FRANCISCO, CALIFORNIA, U. S. A. •

board member at the request of the board of directors.

For the last 8 years, Rand has been a Monsanto vice president and since November, 1943, when he became a member of the executive committee, has had his headquarters in St. Louis.

A native of Watertown, Massachusetts, and a graduate of Harvard University, Rand entered the organization in 1921 through the Merrimac Chemical Company, Everett, Massachusetts, serving successively as treasurer, sales vice president and treasurer, executive vice president and president.

Twin oil pioneers

J. Edgar Pew and John G. Pew, twin brothers whose outstanding careers in oil, natural gas, and transportation have made them two of the best known pioneers in the petroleum industry, were 75 years old on September 27. They spent the day on the job, as usual, J. Edgar as vice president of Sun Oil Company, directing its far-flung oil producing and pipe line activities, and John G. as president of the world's largest commercial shipyard, the Sun Shipbuilding and Dry Dock Company.

During the second great war in which they helped supply the vital combination of oil and ships that speeded victory, J. Edgar actively supervised geophysical and production work that more than doubled Sun Oil Company's crude oil output. John G. directed the expansion of Sun Ship and its construction of 40 per cent of all the oil tankers built in the United States during the war period, in addition to hospital and cargo ships, car floats for the invasion of France, and extensive refinery equipment.

Advertising manager UOP

Announcement has been made of the appointment of Harvey W. Blankenship as advertising manager of Universal Oil Products Company, Chicago, Illinois.

H. W. Blankenship

Blankenship goes to Universal from S. C. Johnson and Son, Racine, Wisconsin, where he served in the capacity of sales promotion manager of the company's industrial division. For a number of years prior to that connection he was advertising manager of Graver Tank and Manufacturing Company, Inc.

In his new position he will direct all activities of the advertising and technical education departments for Universal.

Open Dallas office

Peerless Pump Division of Food Machinery Corporation, in an expansion of engineering and sales has opened an office in Dallas, Texas, 912 Irwin-Keasler Building. W. E. Griffin has been appointed manager of the office.

Relied upon
BY VALVE MAINTENANCE MEN EVERYWHERE . . .
LUNKENHEIMER DISTRIBUTORS
RENDER A SERVICE THAT IS ESSENTIAL—A VITAL LINK IN THE CHAIN OF INDUSTRIAL PRODUCTION
ENGINEERING SERVICE
A DISTRIBUTOR NEARBY TO SERVE YOU
FROM DISTRIBUTOR TO YOUR PLANT
Fig. 1640 "King Clip" Gate
Fig. 16 "Renewo" Globe
Fig. 2125 Bronze Gate

Throughout the war, Lunkenheimer Distributors did a fine job in helping to maintain industrial valve installations at top efficiency.

Located in leading industrial centers, our Distributors have provided quick, readily accessible, and complete valve service throughout the nation.

In addition to supplying high quality, long life Lunkenheimer Valves, they have assisted maintenance men in the solution of both operating and maintenance problems.

This service isn't new...Lunkenheimer Distributors have been rendering it for many years in the past, and will continue doing so in the future. For this Distributor set-up is a basic, permanent part of the Lunkenheimer way—the *better service* way.

You can always depend on your nearby Lunkenheimer Distributor for expert, experienced aid in the solution of valve maintenance and operating problems. Call on him!

The Lunkenheimer Co., Cincinnati 14, Ohio, U. S. A. (Offices: New York 13, Chicago 6, Boston 10, Philadelphia 7. Export Department: 318-322 Hudson St., New York 13, N. Y.)

LUNKENHEIMER VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Running Tour WITH MEN IN THE INDUSTRY

● **James Bradbury,** former division manager of Mene Grande Oil Company of Maracaibo, Venezuela, has been transferred to Caracas as assistant to the president. His post at Maracaibo will be taken by **R. L. Jordan.**

● **E. A. Murray** has been appointed manager of the manufacturers products department in the Chicago sales office of the American Steel and Wire Company, subsidiary of United States Steel Corporation. At the same time, the company announced the appointment of **C. J. Quill** as assistant manager of the department.

● **J. N. Greene,** president of Alabama Gas Company, has been elected a director of the American Gas Association to fill a vacancy until November 1 caused by the resignation of **H. Carl Wolf,** who on October 1 became managing director of the association. **Henry Fink,** general manager of Michigan Consolidated Gas Company, was elected a director to fill the unexpired term ending October 31, 1946, caused by the death of John W. Batten, former president of the Michigan company.

● **H. E. Ferrill** has returned to Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, as sales and development engineer in the brass department, according to George R. Allen, general sales manager of that division. Ferrill has returned to the company after 4½ years in the armed forces.

● **Harry A. Ells,** manager of the natural gasoline and chemical division of Cities Service Oil Company, Bartlesville, Oklahoma, will leave that position November 1 to head the Kansas-Oklahoma activities of the United Carbon Company, Charleston, West Virginia. He will be placed in charge of office now being established at Liberal, Kansas. Ells joined Cities Service in 1923 and since 1940 has been manager of the gasoline and chemical division.

Harry Ells

● **A. S. Rairden,** sales manager of the wire rope department, Wickwire Spencer Steel Company, has just completed a several weeks' trip through the oil country, including California, Texas, and the Mid-Continent.

● **Russell H. Jenney** has resigned from his position with Kentucky West Virginia Gas Company as superintendent of gas measurement to become director and chief consultant of the Measurement and Control Service, Louisville, Kentucky. Jenney has been with the Kentucky West Virginia company for 17 years. He has also been connected with the extension department of several universities in petroleum and mechanical engineering. This new engineering service is divided into 3 separate divisions: Gas utilities, oil refining, and chemical processing. Jenney is offering these industries a complete engineering service on measurement and control problems together with other related problems.

● **Miss Muriel E. Reynolds** and **Mrs. Margery M. Porter,** both of whom started as stenographers, have been named assistant secretaries of Standard Oil Company of New Jersey. They are the first women to be appointed corporate officers of the world-wide concern, Eugene Holman, president, said. Miss Reynolds has been with the company for 19 years, beginning as a stenographer in the accounting division of the producing department. Later she joined the secretary's department and last year became assistant secretary of several subsidiary companies. Mrs. Porter went with Standard in 1930 as stenographer of the sales department of an affiliate. In 1933 she moved into the secretary's department of the parent company and since 1944 has been assigned to the secretary of the executive committee.

Muriel Reynolds

Margery Porter

● **H. J. French** has resigned as assistant director for raw materials and facilities of the steel division, WPB, and has resumed his duties as assistant manager of the development and research division of The International Nickel Company, Inc., of New York. French joined the iron and steel branch of WPB in 1942 and became chief of the metallurgical section. When the steel division was created in March, 1944, he was made chief of that. He leaves Washington after 42 months' service with the Board.

● **Howard C. Pyle** has been appointed vice president of the Bank of America in charge of the newly created oil division, according to L. M. Giannini, president. Pyle began his oil career with the Union Oil Company of California, which organization he served for 14 years. He left Union Oil in 1943 to enter the Army as petroleum engineer with the rank of captain and was promoted to chief of the oil supply rehabilitation and development branch of the quartermaster general's office with the rank of major. In 1944 he was assigned to the general staff of Supreme Commander Eisenhower in the European Theater of operations as petroleum officer. In his new position, Pyle will review geological surveys, consult with petroleum engineers, executives and operators in the industry and will be responsible for maintenance and development of oil industry loan and deposit relations for the Bank of American throughout California and other oil producing areas of the United States.

● **John O. Larson** has been appointed assistant secretary of the Standard Oil Company of New Jersey, according to Eugene Holman, president. Larson, formerly with the coordination planning department of the company, started with Standard in 1927 as a clerk. He has had wide experience in the coordination and economics departments where he participated in studies used in the preparation of world-wide operating programs of the Jersey affiliates. In his new position, Larson will be assistant to A. C. Minton, secretary of the company at 30 Rockefeller Plaza.

● **Thomas G. Bostic** has returned from 33 months with the Army to the Jones and Laughlin Supply Company, and will be sales representative for the company with headquarters at Alice, Texas. Before joining the army, Bostic was local store manager of the Jones and Laughlin Supply store at Bruni, Texas.

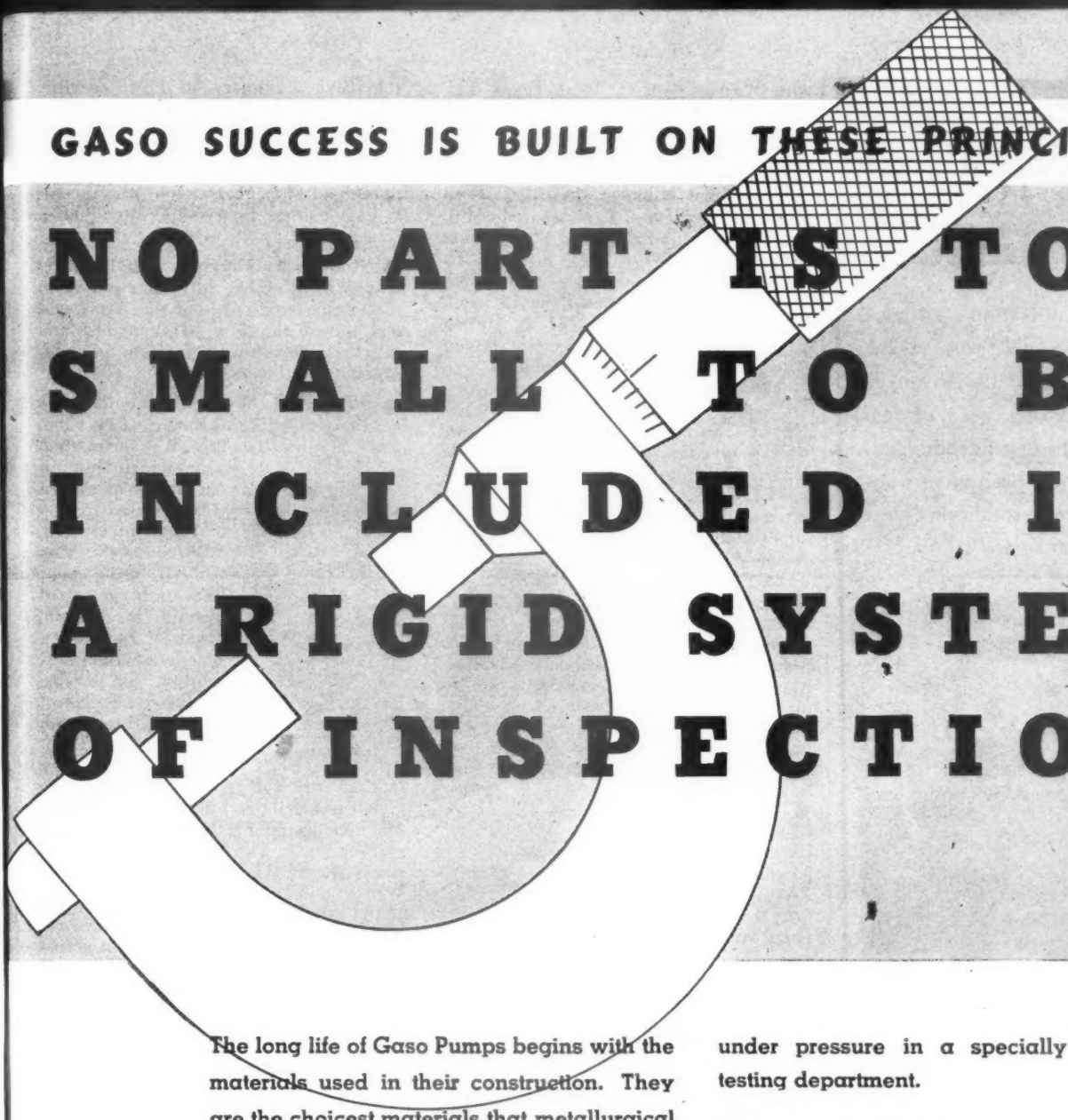
J. M. Peirce

● **John M. Peirce** has joined the staff of the Western Oil and Gas Association, according to Don E. Gilman, vice president. He is an economist and tax consultant and will assist the company in its readjustment problems. Peirce has had 17 years' experience in the field of economics and taxation.

● **C. H. Keen,** assistant division superintendent of the Humble Oil and Refining Company production department, has been transferred from the Louisiana division, New Orleans, Louisiana, to the Southwest Texas division at Corpus Christi, Texas. Other Humble changes include **S. S. Langford,** assistant division superintendent, from the Southwest Texas division, Corpus Christi, Texas, to the Louisiana division, New Orleans, Louisiana; **L. H. Riley,** district superintendent, Wink district, West Texas division, to the Natchez district, Louisiana division; **M. M. Rogers,** district superintendent, Wasson district, West Texas division, to the Wink district, West Texas division; **Homer McCarty,** assistant district superintendent, Wasson district, to district superintend-

GASO SUCCESS IS BUILT ON THESE PRINCIPLES

NO PART IS TOO SMALL TO BE INCLUDED IN A RIGID SYSTEM OF INSPECTION



The long life of Gaso Pumps begins with the materials used in their construction. They are the choicest materials that metallurgical skill and modern facilities can produce. The castings are made to exacting specifications in our own foundry. Special alloy parts are supplied by companies of outstanding reputation according to formulas specified by Gaso engineers.

After the parts are finished they are subjected to an inspection procedure from which even the smallest stud bolt cannot escape. In addition, all parts are tested under pressure in a specially equipped testing department.

When you understand the care used in making Gasos, you also understand the uniformity of these pumps and the consistency of their service records — qualities so pronounced that Gasos were selected to power the military pipe lines that speeded the way to victory . . . Gaso Pump & Burner Mfg. Co., 902 East First Street, Tulsa, Oklahoma. Export Office: 149 Broadway, New York. Shreveport: W. L. Somner Co., 419 Lake Street. Los Angeles: Production Equipment Co., 651-653 E. Gage Ave.

GASO PUMPS

for every oil industry need

ORBIT VALVES

The ease of operation and quick opening—2½ to 4 turns—of the ORBIT Drilling Valve has made it the number one choice of men in the field. Its dependability and ability to give a positive seat under the severest conditions have made it a must—for safety.

Orbit Flanged End Drilling Valve

ORBIT DRILLING VALVES ARE AVAILABLE IN BOTH FULL OPENING AND NOMINAL OPENING SIZES. WITH FLANGED OR SCREWED ENDS.

AT YOUR FAVORITE SUPPLY STORE

See Pages 2194 to 2211 in 1944 Composite Catalog

ORBIT VALVE COMPANY

TULSA, OKLAHOMA

ent, Wasson district, West Texas division. Also **H. D. Dickson,** division civil engineer, from Midland, Texas, West Texas division, to Houston, Texas, Gulf Coast division; **V. A. Walston,** assistant division civil engineer, Louisiana division, New Orleans, Louisiana, to Midland, Texas, and promoted to division civil engineer, West Texas division; **H. E. Meadows** promoted to assistant division civil engineer, Louisiana division, New Orleans, Louisiana; **O. J. Aucoin** promoted to district chief clerk, Bayou sales district, Louisiana division.

Other changes are **T. M. Roper,** district chief clerk, transferred from the Bayou sales district to the Natchez district, Louisiana division; **J. R. Nichols** transferred from Luling, Texas, and promoted to gas plant superintendent, Conroe gasoline plant; **J. A. Lee,** gas plant superintendent, Conroe gasoline plant, resigned to enter business at Kerrville, Texas; **M. A. Mills** transferred from the Katy gas plant to the Hilbig gas repressuring plant, Luling district, as repressuring plant foreman; **I. C. Corbell,** gas plant superintendent, Tomball gasoline plant transferred to the Flour Bluff gasoline plant, and **W. A. Drake,** gasoline plant superintendent, Flour Bluff gasoline plant, transferred to the Tomball gasoline plant.

● **Phillip S. Magruder** has been elected to the board of directors and appointed manager of the manufacturing department of General Petroleum Corporation. The announcement was made in Los Angeles by S. J. Dickey, president of the company. Magruder succeeds the late **Raymond C. Wheeler** who died last August 19.

P. S. Magruder

Magruder joined General Petroleum in 1925 after more than 8 years with Gulf Oil Corporation and Texas Pacific Coal and Oil Company. He was employed by General first as a gas tester, but soon became gas engineer, then general superintendent, and in 1942 manager of the gas department. In May, 1945, he was made assistant manager of manufacturing.

● **Hubert Guyod,** well logging consultant, announces the opening of offices at 730 First National Bank Building, Houston, Texas. Guyod is the author of numerous recent articles on electrical well logging and caliper well logging.

● **F. H. Holmes,** former superintendent of The Texas Company's refinery at Lockport, Illinois, has been transferred to Texaco's Port Arthur works, Port Arthur, Texas, as general superintendent of that plant, according to an announcement by M. Halpern, vice president in charge of refining. **D. P. Bailey,** Port Arthur's general superintendent, has been made assistant works manager. **F. L. Wallace** remains as works manager. **L. V. Phillips,** superintendent at the Texaco refinery in Lawrenceville, Illinois, for the last 2 years, has been transferred to Lockport to take the post vacated by Holmes. Phillips' position at Lawrenceville has been filled by the appointment of **F. M. Dawson,** who recently has been a refinery superintendent in Argentina.

● **Robert W. Harrison** has been released from active duty as a major in the engineering corps of the Army and has joined the firm of Boatright and Mitchell, consulting petroleum and natural gas engineers, Houston, Texas.

● **Francis O. Wyse,** 48, for 19 years publicity manager of Bucyrus-Erie Company, South Milwaukee, Wisconsin, died recently following an illness of almost 14 months.

F. O. Wyse

Born in Salem, Massachusetts, May 4, 1897, Wyse spent the early years of his life in Toronto, Ontario. Following an educational interruption for service in the U. S. Navy, he graduated from Massachusetts Institute of Technology in 1919 with a degree in mechanical engineering. He later joined the Blanchard Machine Company, Cambridge, Massachusetts, from which position he went to Bucyrus-Erie Company in 1924.

In 1926 he took over the management of the publicity department.

● **E. C. Welch** has retired from active duty with the Ohio Oil Company and will be succeeded by **Earl S. Mardis,** promoted from assistant division superintendent to the position of division superintendent vacated by Welch. The latter started with Ohio Oil in the pipe line department at Casey, Illinois, in 1906 and has worked in numerous positions. He had been in the pipe line industry for 43 years. Mardis joined Ohio Oil in Robinson, Illinois, in 1918. Since 1941 he has been assistant to Welch.

● **G. M. Stewart,** New York representative of Hunt Export Company, left September 22 for an extended tour of the oil fields of South America following a sales conference in Houston, Texas. Hunt Export has recently opened an office in Buenos Aires, Argentina.

● **Tom E. Ward,** president of Oilfield Equipment Company, New York, has recenty returned from an extended business trip to London, England, and other points in Britain.

● **N. E. McKinney,** for the last 8 years sales manager of the Thompson Tool Company, Iowa Park, Texas, has recently resigned to go into the general insurance agency business in partnership with his son in Abilene, Texas. McKinney has been closely associated with Middle West and Gulf Coast drilling activities in connection with the Thompson shale separator and sample machine.

● **Alfonso Antonio Chiriboga,** who for some years has been in California study-

ing and training in petroleum engineering at the instigation of the Government of Ecuador, will return to his country where he will be inspector general of petroleum. Chiriboga is a graduate in petroleum engineering from the University of Southern California. He was after graduation employed by Richfield Oil Corporation, but for the last 10 months has been with Shell Oil Company.

● **Ray C. Lewis** has recently been appointed chief geologist of the Houston Oil Company of Texas, it has been announced by R. R. Hobson, general manager. At the time of his appointment, Lewis was Houston district geologist of Stanolind Oil and Gas Company, having been with that company since 1934. In his new position with the Houston Oil Company, Lewis will have complete charge of the geological department.

Ray C. Lewis

● **Howard M. Nichols,** plant manager of the Philadelphia refinery of The Atlantic Refining Company for the last 22 years, has retired, according to E. J. Henry, vice president and general manager of refineries. Nichols has been in the service of the company since 1904. **W. F. Stroud** has been named plant manager succeeding Nichols and **D. T. Shaw** has been appointed assistant plant manager.

● **Frank M. Hodges,** district manager for the Republic Supply Company, Wichita Falls, Texas, died October 5 following a heart attack suffered while returning to his offices from a business trip. He had been connected with the Republic Supply Company since 1916 and had been in Wichita Falls since 1923. Hodges was 52 years old.

● **Marshall B. Taft,** formerly of the aero division, Minneapolis-Honeywell Regulator Company, has been made assistant to Henry F. Dever, president of the Brown Instrument Company, Philadelphia industrial division of the Honeywell organization. Taft was for 3 years administrative assistant to the vice president of the aero division in Chicago. Before that he practiced law in Minneapolis.

● **Laban E. Harmon** has been named by the board of directors as secretary of Standard Oil Company of Indiana. He succeeds **Felix T. Graham** who resigned because of ill health.

● **Major Robert W. Harrison,** who helped lay the pipe lines and build the storage across Northern France, has been named to succeed Lieutenant Colonel **A. C. Small** as head of the petroleum section of plans and training division in the office of chief engineer, War Department. Captain **Joe J. King** who has been assistant to Colonel Small has been discharged and is now back with The Texas Company in Houston, Texas.

The World's Standard of Quality in Oil Field Equipment - - - -

Acme — Since 1900

Pattin — Since 1888

Pattin *Ruggedness*— a Tradition Gone Modern

There are many "performing examples" of Pattin RUGGEDNESS in the Oil Country that are now serving ***well*** their ***second generation*** of owners. Thus it is established fact that Pattin Engines, Powers and Compressors are built for ***life-long*** dependable, economical service.

It would be amazing to know the revolutions those "Old Timers" have made and the equivalent in "road mileage" — compared with the ***potential*** of present-day ***high-speed*** units.

While adhering to the Pattin ***tradition*** — that RUGGEDNESS is the ***safest*** foundation for enduring efficient, economical performance in oil field equipment — improvements in design and operational refinements have kept pace through the years.

Guided by long experience and a firm conviction that comparative slow speed, single cylinder, heavy-duty engines ***deliver*** far more ***power,*** at much less cost, over the long pull — meaning greater hole footage drilled or volume of oil lifted — we continue to ***specialize*** in them.

*(**Note:** Supporting our "stick-to-itivness" and prediction is the new trend toward slower speed units — as revealed by our recent visits to principal fields.)*

PATTIN BROS. ENGINES
POWERS — COMPRESSORS

"GLUTTONS for Life-Long Punishment"

Write TODAY for New Catalog

Wear More— "Drilmor"

Acme Drilling Jars: Famous since 1900 for their longer wear, as measured by footage of hole drilled. Forged only of correct jar steel, meeting Acme's rigid specifications for proper heat treatment — by long-seasoned craftsmen especially skilled in jar making. Furnished in either Rein Welded type (Fig. 107) or "Drilmor" Weldless.

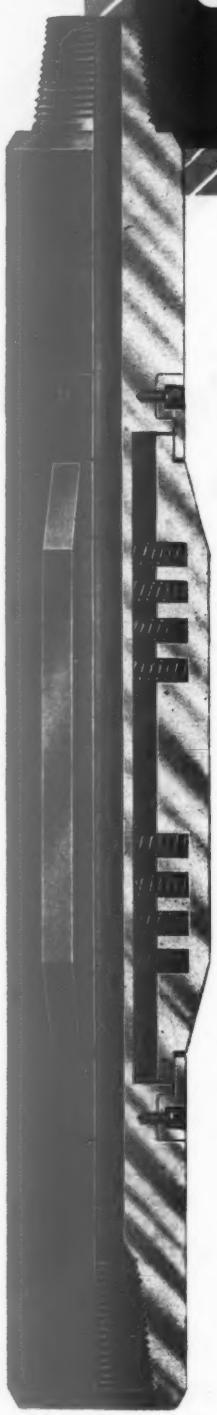
Fig. 107 See Acme — Composite Catalog.

ACME FISHING TOOL CO.
PARKERSBURG, W. VA.

PATTIN BROS. DIV. *of Acme Fishing Tool Co.* MARIETTA, OHIO

Export Office: 19 Rector St., New York 6, N. Y.

CASING SHOULD BE SCRAPED WHILE THE RIG IS UP



especially when the time comes to "complete" your well with the successful

BAKER

ROTARY CASING SCRAPER

Unless the inside of your casing—the "working surface"—is smooth and clean, there always is danger of encountering difficulties in future down-hole work. The use of a Baker Rotary Casing Scraper eliminates that hazard, for it effectively removes all hardened cement, scale, burrs from gun-shot holes, and other obstructions, leaving the casing smooth and clean to its full I.D.

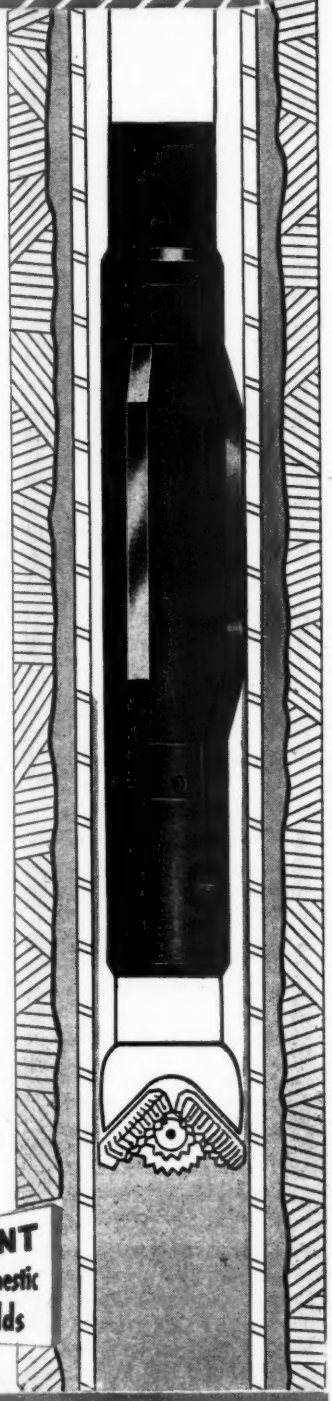
PREVENTS FUTURE DAMAGE TO PACKERS OR SWABS

When casing has been cleaned of all inside obstructions by a Baker Casing Scraper, you *know* that the rubbers on packers and swabs will not be damaged in your future operations—you *know* that no burrs from gun-shot holes remain to interfere with later down-hole work.

TIMING IS IMPORTANT

The time to do a scraping job on your casing is while all equipment is still in position and the crew is on hand. It is then a simple inexpensive matter to include a Baker Rotary Casing Scraper in the string as a "follow-up" behind the bit when drilling out cement. That is the "ounce of prevention" which will leave your casing smooth and clean to its full I. D., and save a "pound of cure" at some future time.

Look on Page 357 of your Baker (or Composite) Catalog, then call the nearest Baker representative for action.



Product No. 620

BAKER OIL TOOLS, INC.

Houston — Los Angeles — New York

YOUR CREWS CAN RUN IT EASILY — SENSIBLE RENTAL RATES

BAKER Rotary Casing Scraper

LAUGH WITH BARNEY

A shipwrecked sailor, who spent three years on a desert island, was overjoyed one day to see a ship drop anchor in the bay. A small boat came ashore and an officer handed the sailor a batch of newspapers. "The captain suggests," he told the sailor, "That you read what's going on in the world and then let us know if you still want to be rescued."

After giving the private a dressing down for being so late in returning with the supplies, the sergeant demanded, "Okay, let's hear how it happened, Miller."

"Well, I picked up a chaplain along the road," explained the woebegone rookie, "and from then on the mules couldn't understand a word I said."

Super-Salesmanship

A super-salesman was going to commit suicide by jumping into a river. A policeman ran up and stopped him, saying:

"Here! You can't do that."

"Oh, can't I?" said the super-salesman.

He talked to the policeman for ten minutes and then they both jumped in.

It was in Toronto that a Victory gardener, speaking for the entire clan, declared: "I am growing beans, peas, tomatoes, squash and tired."

Two old maids were in an insane asylum for years, always knitting. "Gee," sighed Mayme one day, "I wish some tall, handsome man would wind his arms around me and squeeze me until I gasp."

"Now you're talking sense," replied Jane, "You'll be out of here in a few days."

Dentist: I'm sorry, but I'm all out of gas."

Girl in chair: Ye Gods! Do dentists pull that stuff, too?"

Sailor, walking into recruiting office: "Gimme that ol' sales talk again—I'm gettin' kinda discouraged."

"I believe I am a little better, doctor, but I am still short of breath."

Doctor: I can stop that completely after a few more treatments.

Man blames Fate for other accidents but feels personally responsible when he makes a hole in one.

Bridget had been discharged.

Extracting a $5.00 bill from her wage roll, she threw it to Fido.

Then the shocked mistress heard her exclaim:

"Sure'n I niver fergit a friend. That's for helpin' me wash the dishes."

Two men were seated together in a crowded bus. One of them noticed that his friend had his eyes closed.

"What's the matter, Bill," he asked, "feeling ill?"

"No, I'm all right," answered Bill, "but I hate to see ladies standing."

A colored woman had frowned on her husband for many days. Then, like a burst of sunshine from a cloudy sky, she smiled.

"Does that mean, honey, that you forgives me?"

"Go on away, you rascal, I was just restin' ma face."

Doctor: "Why do you have BF-7640 tattooed on your back?"

Patient: "That isn't tattoo. That's where my wife hit me with the car while I was holding the garage door open."

Maybe what Germany lacked to keep down the rise of fascism was a hearty sense of humor. Certainly that welcome attribute so evident in the character of the free people of Merrie England discouraged the spread of that insidious philosophy in the tight little island of Britain.

Before the war Sir Oswald Mosley and a little band of humorless followers sought to bring the "blessings" of fascism to England, but were placated in this cheerful but effective fashion. At a meeting of "British Fascists" Sir Oswald, surrounded by a bodyguard of Black Shirts, marched to the platform and, standing in the glare of a huge spotlight, portentiously raised his right arm in the fascist salute.

Out of the trembling silence there came a clear voice from the balcony: "Yes, Oswald, you may leave the room."

A woman drove into a filling station in one of those bantam cars and tooted her horn. The attendant came out running and stopped on sight of the miniature car. Said the driver:

"Sonny, I want a cup of gas and a tablespoon of oil."

Dismayed, the attendant glared down at her and shouted: "And I suppose you want me to belch in your tires?"

"But, officer, I didn't see that fire plug. When I parked here, it was hidden behind an airedale."

The tired businessman arrived home. The cook had left that morning without giving notice. The market had been depressed all day, and, now, he found a farewell note from his wife.

He knew that a shot would end all his troubles. So he opened a bottle and took a big one.

Then there's the fellow with the stern look because his mother was frightened by the rear end of a ferry boat."

"Would you call for help if I tried to kiss you?"

"Do you need help?"

"Why don't you use that other straw?"

"This one's not empty yet."

A young medical interne had a habit of walking past the psycho ward each morning; in the yard of the ward one of the inmates was always going through the motions of winding up and pitching an imaginary ball. "Why do you stop every morning and watch that screwball go through his pitching motions?" one of the doctor's friends asked him. "Well," he replied, "if things keep going the way they are, I'll soon be out there with a glove catching for that fellow, and I want to get on to his curves!"

Woman: Without her, man would be a savage.

Woman, without her man, would be a savage.

The Solution For Solving the Problem of Boiler Scale and Corrosion

↓

SAND-BANUM

"The Entirely Different Boiler and Engine Treatment"

Here's Whys for the Wise

This proved product is a pure colloidal compound, guaranteed absolutely harmless to personnel and equipment. It removes and prevents scale and corrosion in boilers and tubes while the equipment is operating; its action entirely automatic.

Comes ready to use immediately as is—anywhere and everywhere—simplicity itself. Requires no special equipment, or titrating—has no carrying agent; just 100% active ingredients. Retains full efficiency regardless of age, climate, water or operating conditions; eliminates need of water analyses. Comes in 16-oz. cans taking up a minimum of space.

Its consistent use results in operating efficiency, lessens repair bills, reduces fuel cost, eliminates mechanical scrapings and lessens time out of service; fewer and shorter shut-downs.

Complete data will be gladly sent on request. You can rely on Sand-Banum's record of service for more than nineteen years. It has been consistently used by representative companies here and abroad over a long span of years.

Don't Delay—Write Today

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and at other convenient points including leading supply houses

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Officials promoted

Election of Robert B. McColl as executive vice president of American Locomotive Company has been announced by Duncan W. Fraser, president. McColl is succeeded as vice president in charge of manufacturing by W. L. Lentz of Schenectady who directed the company's vast tank and locomotive manufacturing program there the past 5 years.

McColl has the distinction of being one of the few American members of the Institute of Mechanical Engineers, London, and has been engaged in locomotive manufacture since boyhood when he started as an apprentice with the Glasgow and Southwestern Railroad in Scotland.

After a period with the original builder of the steam locomotive, Robert Stephenson and Sons in Darlington, England, he went with the Montreal Locomotive Works in Canada, an affiliate of American Locomotive Company. After World War I he was with the Armstrong Whitworth Company in England but soon returned to this side with American Locomotive Company as assistant manager of the Schenectady works.

He has since been successively manager of this plant, president of the company's diesel engine manufacturing division, known as the old McIntosh and Seymour Corporation, president of the Alco Products Division of the company, and vice president in charge of manufacturing for the locomotive company. During the war period, he directed the company's huge war production program, which included tanks, gun carriages locomotives, synthetic rubber refining equipment, bomb casings, shells, Navy forgings, and, most recently, materials for the atomic bomb project.

R. B. McColl

W. L. Lentz

McColl was educated at Kilmarnock Academy and the Science and Art College, in his native Kilmarnock, Scotland.

Lentz, formerly with the New York Central System, took over the management of the Schenectady plant at the outset of the war and supervised the conversion of the plant from its exclusive locomotive building operations to what was at one time the country's second largest tank producing arsenal.

An aviation cadet and artillery officer in the last war, Lentz began railroading in 1913 with the New York Central. For an interval after 1937 he was sales manager of the Standard Stoker Company.

Made vice president

Harry G. Howell, one of the nation's foremost forging specialists and an authority on factory management, is the new vice president of Tube Turns, Inc., Louisville, Kentucky, in charge of production. A native Kentuckian, he returns to the Bluegrass after 4 years as head of Oldsmobile's plant and a total of 22 years' association with General Motors. Born in Kilgore, Kentucky, he attended Purdue and began his career with GM's Buick division.

H. G. Howell

New district manager

Thermoid Company, Trenton, New Jersey, has announced the appointment of Oscar Nuss as district manager of its industrial rubber products division. Nuss will serve the Southern California, New Mexico, and Arizona areas.

Nuss joined the Thermoid Company when it acquired the Los Angeles plant of the Grizzly Manufacturing Company in January, 1945. He will make his headquarters at the Thermoid of California plant in Los Angeles.

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for the Petroleum Industry

Because OUR Business, is YOUR Business—here, you will find the answer to everything Electrical for the Petroleum Industry. Intimate, day-by-day working knowledge gives our Engineers experience to quickly meet your requirements; adequate manufacturing facilities to supply the equipment WHEN YOU REQUIRE IT.

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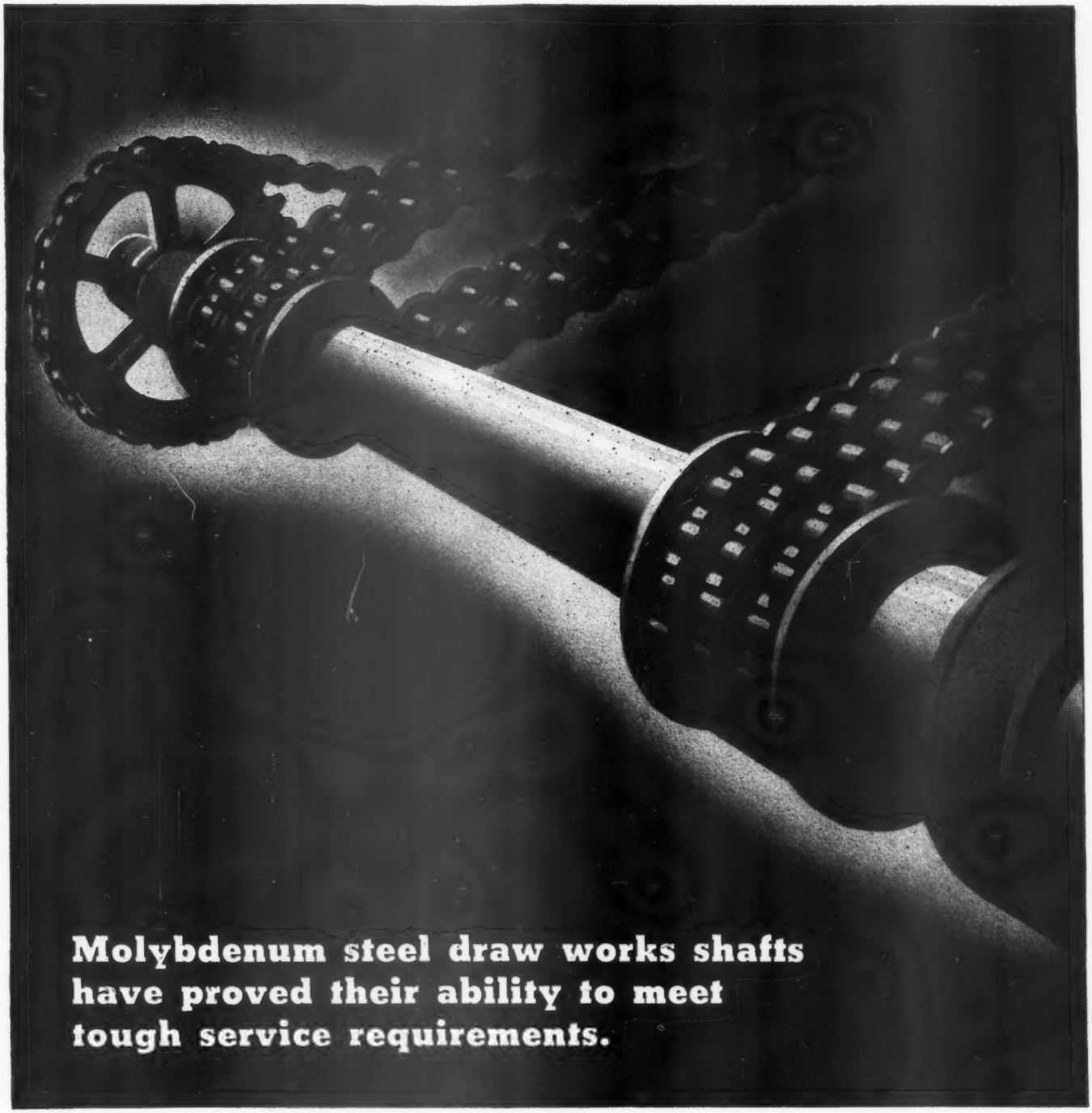
Unit Substations



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Company officials

A. G. Pratt, president of The Babcock and Wilcox Company, has announced the retirement from active service of William Sheldrick, who has been an official of the company for 46 years, and the appointment of W. G. Dryden as his successor.

Sheldrick was treasurer and assistant secretary of The Babcock and Wilcox Company and The Babcock and Wilcox Tube Company. Dryden succeeds to these positions.

Sheldrick was elected treasurer of the company in 1932, and of the tube company 3 years later. Pratt also announced the appointment of C. H. Clash as assistant secretary of The Babcock and Wilcox Company, succeeding F. H. Holloway, who has resigned.

Plant manager retires

Retirement effective October 1, of J. H. Edmonds, general manager, Lebanon, Pennsylvania, plant, Bethlehem Steel Company, has been announced by Quincy Bent, vice president. Walter R. Penman, formerly assistant general manager, succeeds Edmonds.

Edmonds has had a long and successful career in the steel industry. He has been general manager at Lebanon since 1928 and connected with Bethlehem Steel since 1907, when he entered the Lebanon plant as a learner. He progressed to works accountant, production engineer, and assistant to the general manager, and, in 1919, was appointed assistant general manager. He has long been recognized as one of the leaders in the bolt, nut, and rivet manufacturing industry, the Lebanon plant being one of the largest in that field.

Edmonds is a member of the American Iron and Steel Institute, the American Petroleum Institute, and the American Standards Association.

Penman's entire industrial career has been with Bethlehem Steel. He entered the employ of the company at Lebanon in 1919 and has been assistant general manager since 1940. He is secretary of the committee on screw threads of the American Standards Association and a member of the American Petroleum Institute.

Robert L. Riley, assistant factory superintendent and superintendent of the Bethlehem-Lebanon Forge Company during the war, succeeds Penman as assistant general manager.

Richmond officials

Election of R. C. Stoner as chairman of the board of the Richmond Petroleum Company of California is announced. Norman Hardy has been elected president. Richmond, a Standard of California subsidiary, currently is engaged in exploratory work in Venezuela and Colombia.

R. C. Stoner

Norman Hardy

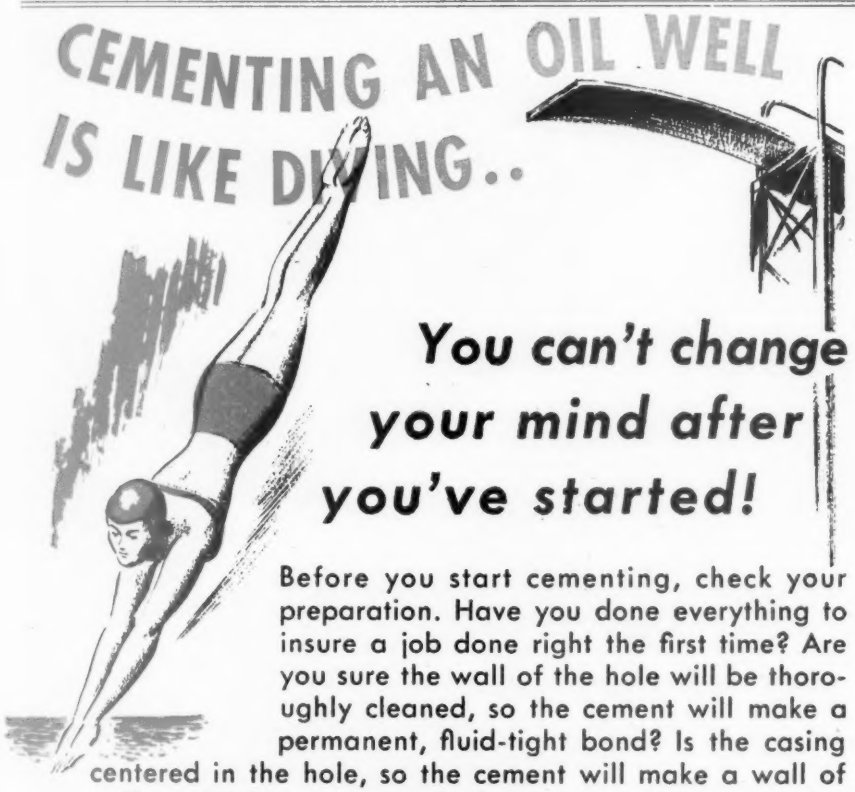
Manager technical service

John E. Slaughter, Jr., vice president of the Girdler Corporation, Louisville, Kentucky, in charge of the firm's Votator Division, announces the promotion of Dr. Harold G. Houlton to manager of Votator's technical service.

H. G. Houlton

Among Dr. Houlton's important new responsibilities are maintaining close personal contact with major research groups in the process industries, selection of additional fields for research and development by Votator, and the study, evaluation, and accumulation of process data for new or outside processes that the division may acquire as part of its comprehensive postwar expansion program.

Dr. Houlton, a native of Seattle, obtained his Ph.D. in chemistry at the University of Washington, and was associated with the process development department of Proctor and Gamble before joining The Girdler Corporation's Votator Division in 1942.



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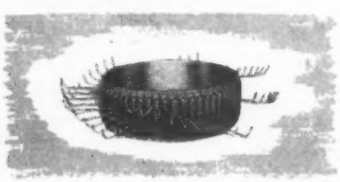

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A. F. Corwin retires

Arthur F. Corwin, vice president, director, and a member of the executive committee of the Socony-Vacuum Oil Company, Inc., retired on October 1. He has been in charge of crude oil production for the company.

A. F. Corwin

Having been in the petroleum business for 46 years, Corwin is widely known among oil men here and abroad, including some of the pioneers in American crude production. Corwin was graduated from the Sheffield Scientific School at Yale University in 1899 and entered the oil business in the fields of West Virginia and Pennsylvania.

He became president of the Carter Oil Company in 1915 and remained with that company until 1926. At that time he was made a director of the Standard Oil Company of New York and then a director of Socony-Vacuum, its successor, in 1932. He has been a member of the executive committee since 1933 and a vice president since 1934.

Corwin lives at 87 Tanglewylde Avenue, Bronxville, New York, and has actively engaged in civic affairs of the village. He served as trustee of the village from 1919 to 1922, president from 1922 to 1923, and a member of the Village Planning Commission from 1923 until 1926.

Callos vice president

Klau-Van Pietersom-Dunlap Associates Inc., Milwaukee advertising agency, has announced the election of George J. Callos as vice president and account executive.

Callos was formerly advertising and public relations manager of Allis-Chalmers Manufacturing Company, and last year was chosen by a national group of advertising men as the nation's industrial advertising man of 1944. In addition to his work at Allis-Chalmers, Callos directed the advertising and public relations program of the Milwaukee County Community War Chest for the last 2 years. He is a director of the Milwaukee Better Business Bureau and last year served as a member of the board of directors of the Milwaukee Advertising Club.

The addition of Callos is the first step in an expansion program at the advertising agency and is expected to add appreciably to the creative staff and strengthen the industrial department.

ENGINEERS WANTED

An oil field service organization has openings for engineers in technical oil field service. Men with one or two years experience in oil production and degree in Petroleum, Electrical or Mechanical Engineering are given preference. Permanent position with long established company. Write giving full details on education, experience, age and marital status. Attach small photograph. Address replies to Box 35, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

Departments merged

With the appointment of Lynn Mahan as assistant to the president in charge of public relations, the American Locomotive Company has established a single department for the company's publicity, advertising, and sales promotion, it has been announced by Duncan W. Fraser, president. This step serves to merge the company's former advertising department with the department of information, placing them under a single administrative head.

H. J. Downes, who has served as American Locomotive Company's advertising manager for many years and who recently became president of E. Mattes and Son, Inc., will act as technical adviser under the new plan. Holmes M. Brown, advertising manager of the Pennsylvania Rubber Company, was named director of advertising effective October 1, and Murray O. Smyth, assistant advertising manager, will serve as assistant director of advertising and sales promotion. Gordon G. Agnew, Jr., formerly of the New York Times and the James O. Peck Company, will serve as assistant to Mahan.

Mahan was recently released from the Army Air Forces, in which he served as major. He was before the war in charge of the locomotive company's information department. He was formerly an associate of Earl Newsom and Company, and prior to that was vice president of Thomas W. Parry Corporation, St. Louis.

Back on job

William D. Mason, assistant to the president of Sun Oil Company in charge of industrial relations, has returned to work after a severe 3-month battle with typhoid fever in which he served as guinea pig for the new wonder drug, streptomycin. He was the "Mr. B" in Collier's August 18 story on the magic germ killer, and the first human being ever to receive intravenous injections of the drug.

Chief metallurgist

The appointment of Charles T. Evans, Jr., as chief metallurgist for the Elliott Company, Jeannette, Pennsylvania, is announced by R. B. Smith, engineering vice president.

Evans, formerly manager of the carbide department of the Titusville plant of the Universal-Cyclops Steel Corporation, has been concerned with the development of high temperature resistant steels for application to high-temperature steam and refinery valves, turbochargers, jet and rocket propulsion equipment. Another of his developments was a method for providing tungsten carbide bullet cores that, mounted in shells, were effective in stopping German tanks.

One of the active organizers of the Northwestern Pennsylvania chapter of the American Society of Metals, Evans has, since 1941, served as a member of the National Advisory Committee for Aeronautics.

In his new assignment he will be responsible for the metallurgical problems of the whole Elliott Company, with particular attention to the metallurgical aspects of research and production of gas turbines.

Oil-shale testing

Exploratory drilling has been undertaken to determine the character and extent of the oil-shale deposits at the site of the new oil-shale mine being opened by the U. S. Bureau of Mines near Rifle, Colorado, Dr. R. R. Sayers, director of the Bureau, has reported to Secretary of the Interior Harold L. Ickes.

The E. J. Longyear Company of Minneapolis, Minnesota, contractor, recently began the first of three diamond core drill holes to be sunk on the Book Cliffs Plateau in western Colorado's Garfield County, Dr. Sayers said. Information acquired in the drilling will be used in developing the mine, which will supply raw materials for the $1,500,000 demonstration plant now under construction as a part of the synthetic liquid fuels program to provide industry with the "know how" in converting oil shale and coal into gasoline and oil.

This work also marks the beginning of an extensive survey of the United oil-shale reserves to give the Navy the facts on the extent and quality of its shale. Cooperating in the current drilling project on Oil-Shale Reserve No. 1, the Navy Department plans geologic and topographic surveys of the reserves and some core drilling to determine the thickness of the shale beds.

The three holes now planned, two 800 ft. in depth and the third 2600 ft. deep, will be drilled a quarter of a mile apart in the form of a triangle. Cost of the drilling, estimated at $34,325 in the contract signed with the Longyear Company, will be computed on a unit or per-foot-drilled basis. The Bureau of Mines and the Navy Department will share drilling and sampling expenses on the 2600-ft. hole. All samples will be analyzed at the Bureau's Oil Shale Research and Development Laboratory at Laramie, Wyoming.

Firms join

An announcement by J. M. Bowlby, president of The Eagle-Picher Company, informs of the acquisition of a substantial interest in the common shares of McArthur, Irwin, Ltd., by Eagle-Picher. "This stock purchase represents another forward step in the post-war expansion program of Eagle-Picher," declared Bowlby, "and marks the active interest of Eagle-Picher in the lead business of our Canadian neighbor."

This joining of interests of two great enterprises is particularly unusual in view of the fact that each firm is more than 100 years old.

New sales agents

Larkin Packer Company, Inc., St. Louis, Missouri, has recently appointed Hunt Export Company as its export representative. Offices of the selling organization are maintained in New York, Houston, and Buenos Aires, and other offices will be established at other strategic points among export centers for the oil trade as readjustments to normal, prewar conditions are effected.

In line with present expansion of sales in domestic fields, Larkin also announces the appointment of the E. C. Dilegard Company as sales representative in the Rocky Mountain territory.

Bethlehem warehouse

Bethlehem Supply Company is erecting a central warehouse at Craig, Colorado, from which it will serve all the principal oil fields in western Colorado, including Moffat, Wilson Creek, the new Rangely field, and the large number of wildcats now drilling in that area.

H. V. Harder, formerly district manager at Wichita Falls, Texas, has been transferred to Craig as district manager for Colorado and Wyoming district. This district will come under the general supervision of V. W. Bailey, division manager, who make his headquarters at Tulsa.

Riley elevated

J. C. Riley, Jr., has been appointed assistant manager of sales of the D+B Mid-Continent division of Emsco Derrick and Equipment Company. Riley will be in charge of sales in the states of Oklahoma, Kansas, Illinois, Indiana, and Kentucky.

J. C. Riley, Jr.

Riley joined D+B in January, 1938, and since that time has represented the organization in several different sections of the Mid-Continent area. Starting with the Wichita Falls-Panhandle territory in 1938, he later served in Ada, Oklahoma, Centralia, Illinois, Oklahoma City, and more recently has been the D+B representative in Tulsa. In his new position, Riley will continue to make his headquarters in Tulsa and in addition to sales responsibilities, will be in charge of operation of Continental D+B stores in the states mentioned.

Joins Dearborn staff

Announcement is made by the Dearborn Chemical Company, Chicago, of the appointment of F. E. Rolston as packaging engineer.

F. E. Rolston

Since 1942, Rolston has served the government in the capacity of industrial specialist. He worked directly under the Forest Products Laboratories and was assigned to the office of Chief of Ordnance, Detroit, as Chief of the Spare Parts and Packaging Branch of the Engineering and Manufacturing Division.

Prior to his work with the government, Rolston was president of the Rolston Engineering Company and was also associated with the Chicago Mill and Lumber Company.

Tuxson district manager

Union Wire Rope Corporation, Kansas City, Missouri, announces the appointment of R. O. Tuxson as district manager in charge of its Houston, Texas, branch.

Following its personnel policy of long standing, the Union Wire Rope Corporation brought Tuxson into the organization upon his leaving college. For a number of years he has worked and trained in every department to gain a complete knowledge of the wire rope business. For the last several years he has been district manager in the Kansas City territory, working out of the home office.

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The new E.L.I. Perco Sampler assures you of an abundant representative sample from any depth you select for subsurface oil analysis. A shear-pin prevents premature tripping of the sampler mechanism, but the internal, spring loaded jar mechanism is positive in its action so that a moderate snap on the wire line causes the jar mechanism to close the two valves at either end of the sampler chamber. Tapered valves fitted into correspondingly tapered valve seats and gaskets guard against any possible loss of sample. Furthermore, the valves are pressure operated, resulting in an increasingly effective seal as the pressure differential between the inside and outside of the sampler is increased. • The E. L. I. Perco Sampler recovers over 655 C.C. of sample, an amount more than sufficient to perform all usual tests on the bottom hole samples. A compact transfer head permits the sample to be removed from the sampler and injected into the test apparatus without difficulty.

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Sales executive changes

Two changes in the sales executive organization of Fairbanks, Morse and Company, have been announced by Robert H. Morse, Jr., vice president and general sales manager.

A. G. Brown

New acting manager of the railroad division is John S. King, formerly manager of the company's pump division. He succeeds C. H. Wilson, who is on an extended leave of absence due to his health.

Arnold G. Brown, formerly assistant manager of the pump division, succeeds King as manager of that division.

King is a veteran in the Fairbanks-Morse organization. He started as a student in the Beloit plant where he assembled and tested pumping equipment and diesel engines. In 1921 he was transferred to the Indianapolis plant, a year later became territorial representative of the pump department in Chicago, and in 1930 was made pump department manager of the Chicago branch. In 1937 King was appointed manager of the New Orleans branch and last spring was made manager of the company's pump division.

Brown was general sales manager of the Pomona Pump Company, when it was purchased a year ago by Fairbanks, Morse and Company. Soon afterwards he was made assistant manager of the pump division. A graduate engineer of the University of Syracuse in 1929, Brown traveled extensively as an engineer until 1937 when he went with the Pomona Pump Company as a junior engineer in the sales engineering department. Later he became the firm's southeastern manager, and at the beginning of the war was moved to New York and Philadelphia where he was in charge of the firm's procurement contracts. In 1943 he was appointed assistant sales manager and just before the firm was purchased by Fairbanks-Morse was made general sales manager.

Wilson has been in charge of railroad sales for Fairbanks-Morse since 1932. Except for 4 years, 2 of which were spent as a lieutenant of engineers in the first world war, he has been with the company since 1905. "Charley", as he is known in the trade, has a host of friends who wish him a speedy recovery, and a quick return to his job.

Federated promotes

Federated Metals Division, American Smelting and Refining Company, announces the appointment of Albert Baron as purchasing agent of its Whiting, Indiana, plant.

Baron has been associated with Federated at New York and Detroit since 1928, and for the past year has been assistant purchasing agent at Whiting.

Lund moved up

Election of Gage Lund as chairman of the boards of The California Company and Standard Oil Company of Texas, both Standard of California subsidiaries, was announced in San Francisco October 10.

K. H. Crandall was named president of The California Company, succeeding Lund, and J. W. Hoover was elected a vice president.

Lund's headquarters will be in San Francisco. Operating headquarters of Standard of Texas is in Houston and The California Company in New Orleans.

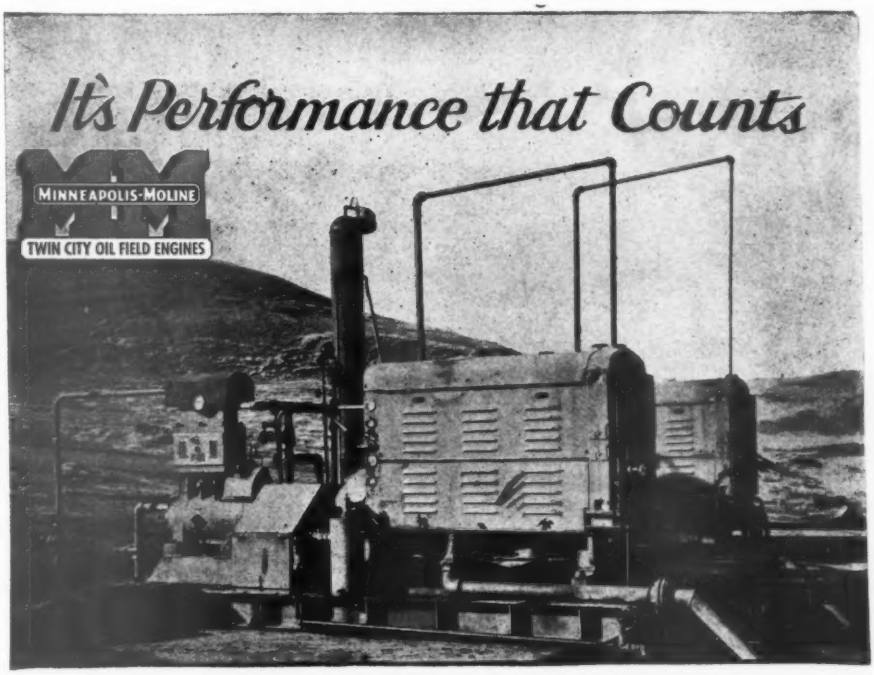
Lease plant

Standard of California has entered into a contract with Reconstruction Finance Corporation under which the oil company will operate the major part of the government-owned 100-octane plant at Richmond.

This plant, one of the nation's largest wartime producers of military aircraft fuel, will manufacture premium quality motor gasoline for automobiles.

Decision to lease the plant from the RFC is a part of Standard's reconversion program that aims toward supplying improved peacetime products and contributing to employment of skilled workers in the West, company officials announce. Operation and maintenance of the plant require approximately 150 technical and skilled personnel.

Designed capacity of the plant is 8000 bbl. (42 gal. each), but during the war it was worked up to 12,000 bbl. daily of 100-octane gasoline. Production of motor gasoline is expected to be approximately 8000 bbl. a day.



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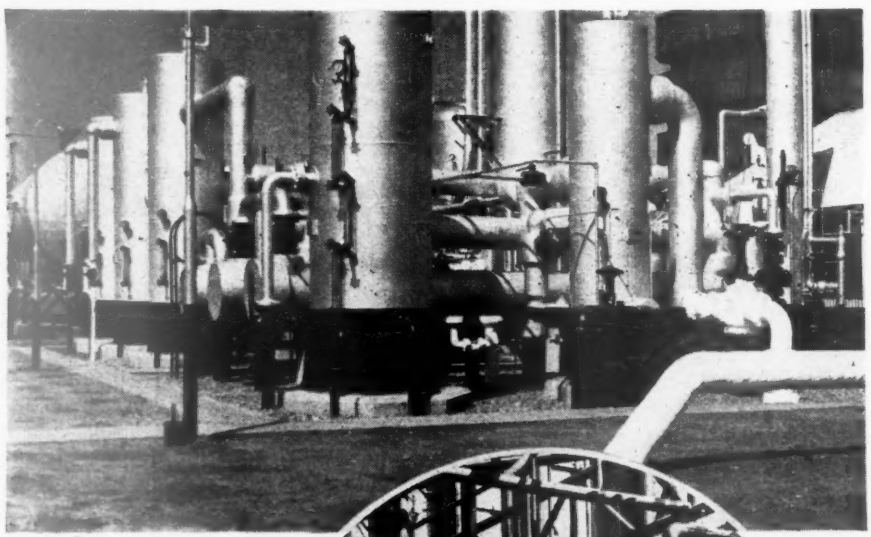
To research institute

Dr. E. N. Kemler has been appointed head of the newly created engineering research division of the Southern Research Institute, Birmingham, Alabama. Dr. Kemler joins the institute from Purdue University where he was professor of mechanical engineering.

In announcing plans for the new engineering research division, Dr. Lazier, the institute's director, said that the institute will ultimately have a specially equipped laboratory for investigations in mechanical and electrical engineering, and will have a staff competent to handle any problems in design and engineering analysis that may arise in connection with providing a well integrated program of sponsored research. The engineering research division will occupy quarters separate from the main laboratory of the institute, which is now largely occupied with investigations in the physical sciences.

Dr. Kemler has been associated with several companies in a consulting capacity and was previously employed by Dodge Manufacturing Company, University of Pittsburgh, Gulf Research and Development Corporation, and was in charge of production engineering work for the Gypsy division of Gulf Oil Company, Tulsa, Oklahoma. During the war years he was engaged in teaching and research work for the armed forces at Purdue University.



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Executive with ability to take full charge of all engineering, research, and development. Must be familiar with oil refinery equipment and construction, general steel plate construction, and general process equipment. Location, midwest. Write giving full information, age, education, experience, salary, references, etc. Box 36, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

WANTED: MINING or PETROLEUM ENGINEER by Major Oil Company. Recent graduate or with some experience, for Exploitation and Production Engineering work. Training course if inexperienced. Write Box 32, c/o The Petroleum Engineer, P O. Box 1589, Dallas, Texas.

WANTED: GEOLOGIST by Large Major Oil Company. Minimum requirements B.S. or B.A. degree, geology major. Previous experience not required. Write Box 34, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

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Major Oil Company requires graduate Mechanical Engineer for Production Department. Either experienced or inexperienced. Write Box 33, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

WANTED: Sales executive experienced in automotive and industrial lubricants to direct activities of established national sales organization. Old, well-known manufacturing company. References will not be contacted until after personal interview. Reply, giving full details of experience, to Box 31, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

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John P. Squier announces a new and scientific *Gas Measurement-Engineering Service* designed for the economical, time-saving, and absolutely accurate computation of natural gas flow charts.

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Elliott officers

Grant B. Shipley, chairman of the board of Elliott Company, Jeannette, Pennsylvania, announces that at a meeting of the board of directors, W. A. Elliott was elected president. Elliott has been executive vice president. Shipley, who remains as chairman of the board, previously was also president.

F. H. Stohr, formerly assistant to the president, was elected executive vice president, and F. W. Dohring, who has been general sales manager, was elected vice president in charge of sales.

Other executive officers of Elliott Company include: R. W. Owens, vice president in charge of manufacturing; R. B. Smith, vice president in charge of engineering; Dundas Peacock, controller, and M. G. Shevchik, secretary and treasurer.

Bartlett appointed

According to a recent announcement by John Dolan, general sales manager, Le Roi Company, Milwaukee, Wisconsin, A. J. Bartlett is now responsible for the sale of industrial engines to original equipment manufacturers.

A. J. Bartlett

Bartlett, who majored in mechanical engineering at the University of Wisconsin, has been with Le Roi Company since 1935 and brings a wealth of experience to this new department. Beginning as a draftsman 10 years ago, he progressed through the experimental department, where he engineered fuel economy tests on engines and air compressors, and the sales department, which he joined in 1936 as a sales engineer. Then his work consisted of organizing the product order department and handling engineering and engine application sales.

Personnel changes

Gordon E. P. Wright and Paul A. Ketchum have been appointed assistant general managers of branches of the Pittsburgh Plate Glass Company.

Wright has been associated with the company since 1916 when he undertook duties of stenographer, translator, patent clerk and safety inspector at the general office. He started what are now the safety and insurance departments. In 1922 he was appointed assistant superintendent of the company's Ford City 4 glass plant. In 1930 he joined the commercial department of the company in a supervisory capacity.

Ketchum entered the company in 1931. In 1932 he moved to the Kansas City branch; in 1934 he was transferred to the Louisville branch as a sales representative. He served as assistant manager at Columbus, Ohio, in 1936, and was appointed manager the following year. From 1939 until his latest appointment Ketchum served as manager at the Toledo branch where his duties included supervision of the company's Ohio units at Lima, Findlay, Tiffin, and Fostoria.

New enterprise

Dover Industries, Inc., announce the start of operations at its plant at 2929 North Campbell Avenue, Chicago 18, Illinois. This is a new enterprise that was organized to manufacture and job metal articles requiring plated finishes. The company's executives have each had from 10 to 20 years' experience in the metal finishing industry. L. D. Jensen, formerly vice president of Chromium Corporation of America, is president; O.A. Wettlaufer and E. L. Berkenkotter, formerly sales manager and plant superintendent, respectively, of Chromium Corporation of America are vice presidents, and K. W. Schwartz, formerly vice president of United Chromium, Incorporated, is treasurer.

An industrial site with 45,000 sq. ft. of available space has been acquired. Modern and complete facilities have been installed for hard chromium plating and heavy nickel plating on equipment weighing up to 5 tons and 22 ft. in length.

The extensive experience of the organization's engineering personnel is available to the oil and petroleum industry in connection with the plating of such equipment as hot oil pump plungers, pump cylinders, sleeves, and diesel engine liners.

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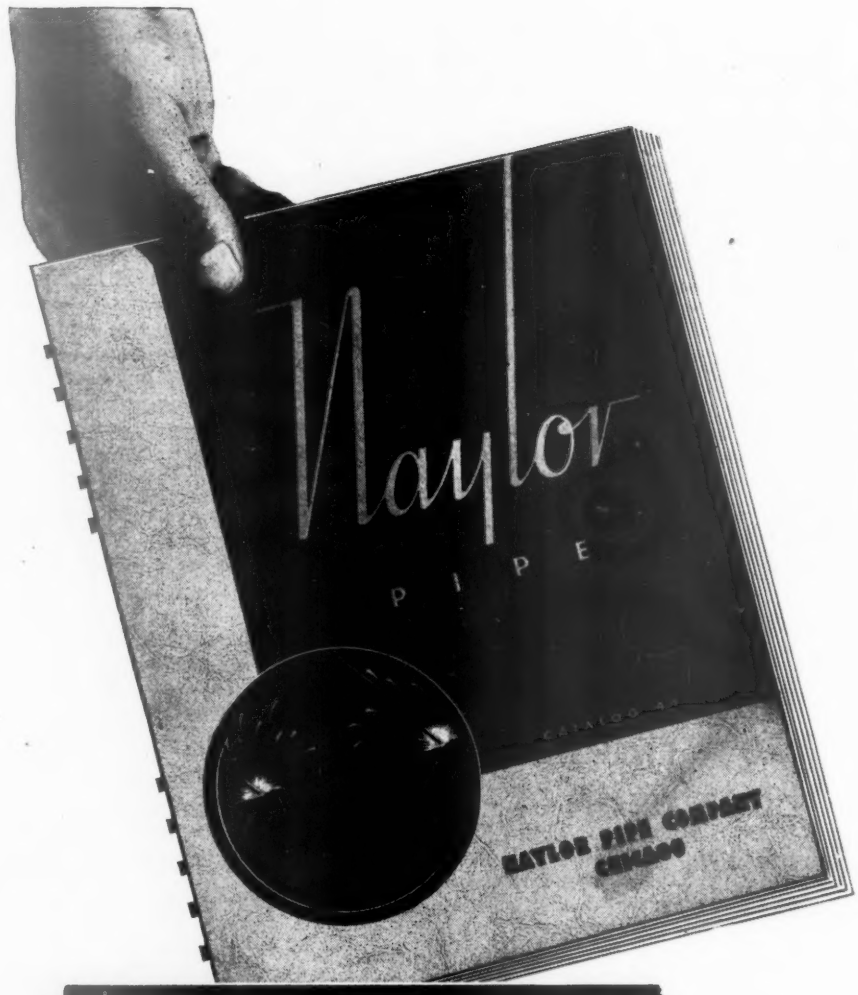

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Construction program

Plans for a construction program totaling more than $20,000,000 is announced by H. D. Collier, president of Standard of California.

This program, suspended by the war, will include additions and improvements to refinery, storage, distributing, producing, and office facilities of Standard and its domestic subsidiaries.

In addition, the company is expanding its tanker fleet at a cost that will approximate $13,000,000 by the middle of next year, and is furthering its plans for drilling and exploration work and for additional expansions expected to develop in the next two years.

"The program," Collier said, "also covers warehousing and shipping installations, new laboratories to keep Standard in the forefront of petroleum technological advances, and modernization of marketing and service station facilities throughout the West."

The largest part of these delayed expenditures will be at the Richmond and El Segundo, (California) refineries, where approximately $15,000,000 will be expended. Included in this latter amount is nearly $2,000,000 for expansion of the Richmond laboratories and plants of California Research Corporation, Standard subsidiary.

Indicating the additional large outlays Standard has in mind, Collier declared:

"We anticipate spending many more millions for normal replacements, repairs and betterments during the next few years.

"Our domestic drilling and exploration program will be continued to uncover new sources of petroleum. While drilling, for instance, may not be maintained at its wartime pace, it still will be one of our largest expense items, requiring substantial manpower and equipment. It might be explained that Standard spent more than $100,000,000 in drilling and exploration work in the past two years.

"Our affiliated and subsidiary companies aso are planning energetic programs in the foreign field — Saudi Arabia, Bahrein Island, Netherlands East Indies, Venezuela, Colombia, Alberta (Canada), and elsewhere. These operations, covering exploration, drilling, refinery construction, and shipping facilities, will entail additional expenditures of many millions of dollars. A large part of these outlays will be for equipment that will be bought in the United States."

Dearborn reconversion

Like many other manufacturers selling to industry, the Dearborn Chemical Company, Chicago, faced comparatively few physical reconversion problems. It was able to reconvert to civilian lines immediately after V-J Day as the products that it manufactured for war service were the same as those produced for peacetime consumption.

The company specializes in scientific water treatment chemicals, the equipment to administer the dosage, and the engineering service to combat corrosive

action of water as scale in locomotive and industrial power plant boilers. It is also the manufacturer of the "original rust preventive," NO-OX-ID and NO-OX-IDized wrappers for rust control on metal parts, structures, and equipment.

The nation's problems of protecting equipment against the ravages of rust while confined in long time storage are occupying a great deal of the company's immediate attention.

During the present war NO-OX-ID acted as a protector for shipments of metal replacement parts going overseas, to guard them from moisture, water penetration, humidity, and other rust accelerators. NO - OX - IDized wrappers impregnated with the same rust preventive chemicals supplemented the coating in protecting this material.

NO - OX - IDized wrappers, it was stated, were designed originally as an overcoat for pipe lines laid along river beds and through corrosive soils to provide physical protection against grinding sands and tree roots and they will be used extensively again for this purpose.

The company's engineers have since developed many new uses for the wrapper, not only as a moisture-proof wrap for packages, but as an inside shipping box liner for food shipments to keep food from dehydrating and at the same time prevent the entrance of outside moisture.

"The wrapper will continue, of course, to be used on pipe lines," Carr continued. "The country's construction of nearly 5000 miles of new pipe lines is anticipated and Dearborn looks forward to its share in protecting these 'life lines'."

NACE meeting

The National Association of Corrosion Engineers announces dates of May 7, 8 and 9 for its 1946 annual meeting and convention, which will be held in Kansas City, Missouri, with headquarters in the President Hotel. In addition to the technical programs covering the 3 days' sessions, there will be an exhibition of corrosion-resistant, corrosion-mitigation, and various types of protective materials in the Main Arena of the Municipal Auditorium.

Technical sessions are scheduled for the same building, in the Little Theatre there, and in such additional space as may be required to accommodate the sectional and group meetings. The program as outlined includes papers on corrosion practices as developed in representative industries, such as power plants, municipal and other waterworks, transportation companies, buried communication lines, refineries, chemical manufacturing and processing plants, and oil pipe lines. Simultaneous sessions are scheduled to permit coverage of the program within the allotted time.

Elected to board

R. P. Tyler has been elected to fill a vacancy on the board of directors of Macwhyte Company, Kenosha, Wisconsin, caused by the resignation of Mrs. George S. Whyte. Tyler is also general sales manager.

FORGED STEEL UNIONS

Your Most Dependable Servants

Petro UNION

America's most universally used Union! A partial list of proven services: Pressures from a vacuum to 3000 lbs. Temperatures from 100° below zero F. to 1000° above zero F. Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and all service in which Steel or Wrought Iron Pipe is used. Made to A.A.R. Standards and priced in line with 300 lb. A.A.R. Malleable Iron Unions.

Write for Pamphlet AM-67.

SIZES ⅛" to 3"

Socket Weld UNION

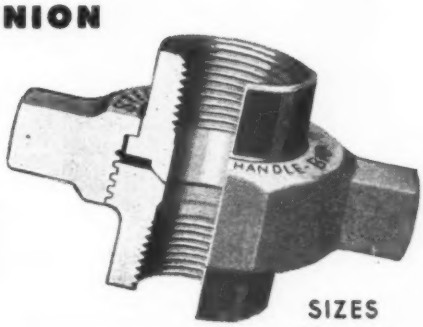
This is our "PETRO UNION" with the end pieces reamed to U.S. Navy Specification B-173 for socket welding. Ends squared to facilitate welding. It has permanently lubricated nut threads and machined and cold rolled steel seats.

Write for Pamphlet AM-67.

SIZES ¼" to 3"

Handle-Bar UNION

4000 AND 6000 TEST



4000 Test: Sizes ⅜" to 1½" V-thread in nut.

4000 and 6000 Test: Sizes 2" to 4" modified Acme Threads in nut.

Steel to steel, or bronze to bronze cold rolled seats. Permanently lubricated nut threads. To tighten, or loosen the nut, USE A HAMMER INSTEAD OF A WRENCH.

Write for pamphlet 4P-HB.

SIZES ⅜" to 4"

ORDER BY TRADE NAME FROM YOUR JOBBER

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS

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1900 DEMPSTER STREET • EVANSTON, ILLINOIS

OPPORTUNITIES
FOR
DRAFTSMEN
Structural Detailers
Heavy-Machine Designers
Experienced in detailing and checking drawings
ALSO
STRESS-STRAIN CALCULATOR
High-pressure equipment, Intensifiers, pumps, Pressure vessels, high-pressure valves.
Major in all higher mathematics State experience and salary desired.
ADDRESS EMPLOYMENT OFFICE
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

"Best Bet Yet"

These oil-proof, wear-resistant, plastic tubing protectors are an integral part of the tubing collar. Made in all sizes, they prevent the metal-to-metal contact that has caused many expensive "wet" jobs in pumping wells in the past.

PATTERSON-BALLAGH TUBING PROTECTORS
LOS ANGELES 1 • HOUSTON 10 • NEW YORK 6

Discusses drilling costs

"Rising costs threaten development of the oil supply," said W. K. Powell of the Two States Drilling Company who spoke recently before the Petroleum Accountants Society at the White Plaza Hotel, Dallas, Texas. Powell was introduced by Wallace March, president of the society.

Powell, who is chairman of the accounting committee of the American Association of Oilwell Drilling Contractors, went further by saying, "Unless development costs are stabilized many oil operators will retard their development program, thus arresting much needed oil discovery and ultimately reducing the output of gasoline, oils, greases, plastics, and other petroleum products so greatly needed to support the industrial and living economy of our United States.

"Rising costs are like a hydraulic ram, compressing the diminishing operating margin of the oil business against the subnormal ceiling of oil imposed by current artificial means.

"Since the possibilities of the use of atomic energy in industry are remote and the products from oil and gas must provide the substantial source of power for everyone from the owner of a cotton gin to the operator of an automobile, anything decreasing the development of future oil reserves should engage the concern of every individual."

Turbine laboratory

Gifts totaling half a million dollars for establishing a gas turbine laboratory at the Massachusetts Institute of Technology for graduate instruction and fundamental research in this new and promising field of engineering, are announced by Dr. Jerome C. Hunsaker, head of the departments of aeronautical and mechanical engineering.

Recent advances in gas turbine design indicate significant possibilities for the future and emphasize the need for specialized technical studies and the discovery of new techniques required in the construction of machines operating at extremely high speed, high temperature, and high compression. The Institute's new laboratory, which is to be completed as soon as possible, will undertake such a program. Its equipment will include a supersonic wind tunnel and unique facilities for research on the elements of compressors, combustion devices, jets, and gas turbines. Test facilities will also be provided for the operation under controlled conditions of such devices.

The gas turbine was applied with spectacular success in jet propelled aircraft and is considered one of the most important technical developments to emerge from the war. As a power plant it holds great promise for many other transportation and industrial uses.

In announcing plans for the turbine laboratory, Dr. Hunsaker said:

"Recognizing the importance of the field and the need for immediate work both in research and in the training of young engineers, the Institute established a faculty committee representing aeronautical, mechanical, metallurgical and chemical engineers to investigate the present status and future potentialities of gas turbines. The report of that committee was emphatic on one point, that the gas turbine field must be recognized as one of the most important objects of study in mechanical engineering.

"The gas turbine promises to be the next major step in the evolution of power plants, comparable in its effect on technology with the steam turbine introduced at the beginning of the century."

To enlarge office building

Humble Oil and Refining Company announces that its plans to construct two additions to its Houston office building situated on the block bounded by Main Street and Polk Avenue, Travis Street and Dallas Avenue.

Work will begin immediately on a 2-story structure as an extension to the main office building to be situated on the site of the courtyard occupying a space 130 ft. by 40 ft. on the Polk Avenue side of the present building. Foundations will be provided so that 7 additional stories can be added to the new structure in the future, if desired.

Upon completion of the 2-story addition, a 10-story addition to the existing building will be erected on the lot on the corner of Main Street and Dallas Avenue approximately 138 ft. by 85 ft., which is now the site of a 3-story apartment building. At the same time a tenth story will be added to the 9-story Travis Street Addition, which was completed in 1940 on the corner of Travis Street and Dallas Avenue.

The entire project is estimated to cost $2,200,000. Kenneth Franzheim-Staub and Rather, associate architects, are preparing the plans for the additions. The American Construction Company is the general contractor.

Appointed distributor

Indiana Equipment Company, Inc., Indianapolis, has been appointed distributor in central and northeastern Indiana for Bucyrus-Erie ⅜- to 2½-yard shovels, draglines, cranes. With the exception of Lake, Porter, and LaPorte counties in the northwest, its territory includes all of Indiana north of, but not including, the counties of Knox, Daviess, Martin, Lawrence, Jackson, Jennings, Ripley, Dearborn.

Headquarters of Indiana Equipment Company are at 327 West Market Street, Indianapolis.

Bucyrus-Erie customers in southern Indiana will continue to be served by Brandeis Machinery and Supply Company of Louisville, while Great Lakes Supply Corporation of Chicago will continue to serve those in the northwest corner of the state. All Indiana distributors for Bucyrus-Erie excavators work with the cooperation of the Bucyrus-Erie district office at 105 West Adams Street, Chicago.

Collins transferred

M. D. Gilbert, district manager for the Tulsa office territory of Pittsburgh Equitable Meter Company—Merco Nordstrom Valve Company, has announced the transfer of Dean Collins, service engineer, from Tyler, Texas, to Shreveport, Louisiana.

Dean Collins

This move was made to locate Collins more centrally in his territory, which embraces northeast Texas, northern Louisiana and Arkansas.

Collins has lived in Tyler since 1937 when he first became associated with the company. In his own right an experienced petroleum engineer, he has made a very wide acquaintance among oil men in his territory. His experience covers the application of the many types of measurement and control instruments made by his firm, including Emco gas meters and regulators, Pittsburgh oil meters, and Nordstrom valves.

Collins' present address in Shreveport is 1101 Janther Place, and his telephone number is 7-7221.

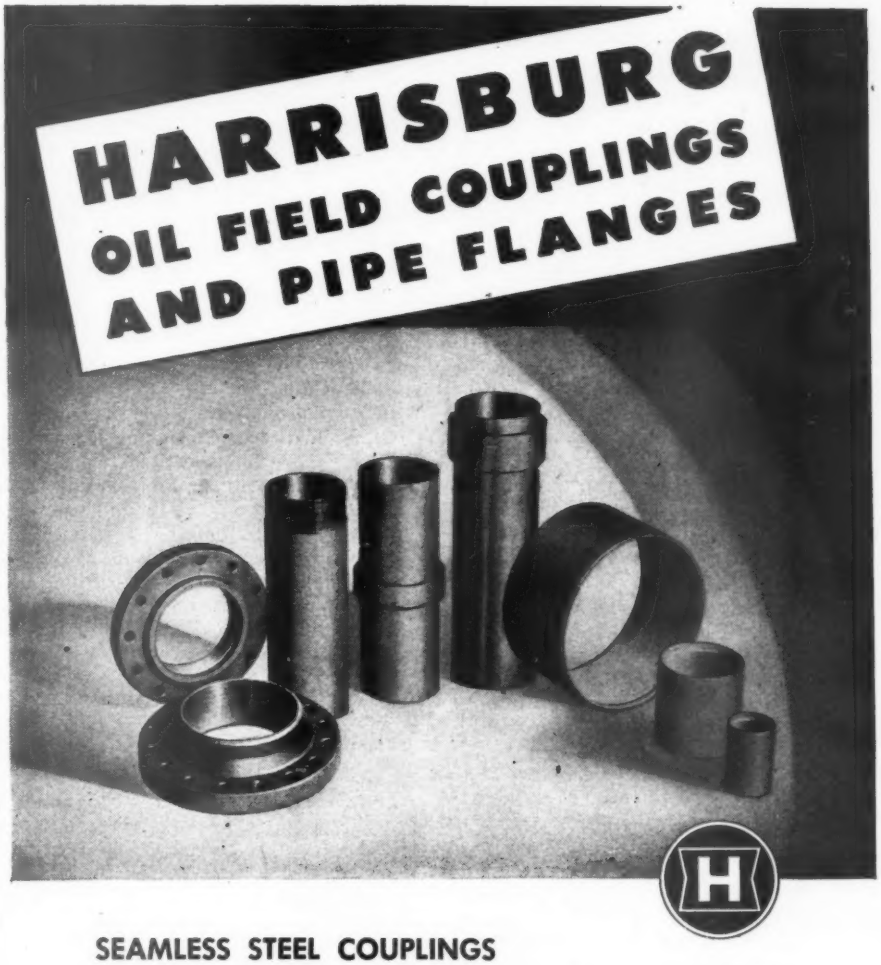
Joins Patterson-Ballagh

Patterson-Ballagh Corporation recently announced the association of R. W. Cypher as a sales engineer with that firm. He is known throughout the oil industry as "Zero," "Bob" or "Cy." He spent his entire life in the oil industry, having been born in Mannington, West Virginia, where his father was working on a wildcat well at the time. The family moved to Orcutt, California, in 1905 where they pioneered the early oil days. Later Bob worked in Taft, Fellows, South Mountain, Signal Hill and, in fact, has had some acquaintance in nearly all the fields of the United States.

After his training at the University of California, he entered commercial business and in 1928 left the drilling phase to sell oil production equipment. From 1934 to 1939 he was sales manager of the Neilsen Pump Company, and later went into business for himself as a general representative acting as sales broker.

He will now represent Patterson-Ballagh throughout the state of California on their entire production line. They have taken over the production and sales of O'Neil swabs, which he will introduce to the trade in addition to handling the sucker rod wiper, wire line wiper, new well seal, and all other equipment designed to make production more efficient.

He will make his headquarters at the Patterson-Ballagh office and warehouse in Los Angeles, California.



SEAMLESS STEEL COUPLINGS

Frequent screwing and unscrewing will not damage the full formed, tough threads on Harrisburg Seamless Steel Pipe Couplings. They will also withstand external abrasion and distortion from constant use of pipe tools. Millions in use throughout the oil industries attest these enduring qualities.

DROP-FORGED STEEL PIPE FLANGES

Harrisburg Drop-Forged Pipe Flanges and Harrisburg Seamless Steel Pipe Couplings are companion products from the standpoint of design, steels, careful threading and machining processes. Harrisburg Flanges can be furnished in all types and sizes, standard or special, in any quantity.

● *THE HARRISBURG CATALOG. Maintenance and purchasing departments should have this 102-page informative catalog on file. It is a source of well organized buying information and related engineering data on all Harrisburg products. Send for it* **now.**

HARRISBURG
STEEL CORPORATION
HARRISBURG, PENNSYLVANIA

Harrisburg Makes: Alloy and Carbon Steel; Seamless Steel Cylinders, Liquefiers, Pipe Couplings and Slush Pump Liners; Drop Forgings and Drop-Forged Steel Pipe Flanges; Coils and Bends.

Joins meter-valve firm

Announcement has been made by A. J. Kerr, general sales manager of Pittsburgh Equitable Meter Company-Merco Nordstrom Valve Company, that Waldo S. Hull has joined the sales division of the company.

W. S. Hull

Hull was associated with the Central New York Power Corporation of the Niagara Hudson System from January, 1927, to October, 1942. He worked in the gas department of the Utica area for this entire period, serving as superintendent of gas transmission and regulation until being called to the War Production Board, Office of War Utilities, in Washington in October, 1942.

In the Office of War Utilities, Hull served as senior industrial engineer in the gas materials section, gas division. He was concerned largely with assigning priority ratings, assisting the gas industry to procure critical materials during war-time. As a result of the relaxation of WPB controls and curtailment of activities of the OWU, Hull was free to accept the Pemco appointment.

In his new connection he will handle the sales and service of Emco gas meters and regulators, and Nordstrom lubricated valves in the Philadelphia and Washington trading area. Hull will make his home in Philadelphia, Pennsylvania.

Quisenberry resigns

Alvin Zwerneman, vice president and general sales manager of the Axelson Manufacturing Company, announces the resignation, effective November 1, of J. L. Quisenberry as advertising manager.

L. F. "Bill" Lutz, who has been a member of the Axelson organization for a number of years, will succeed Quisenberry.

Quisenberry's plans provide for the opening of an advertising agency in Huntington Park.

Buys Ohio plant

Republic Steel Corporation has announced the purchase of The Stevens Metal Products Company, Niles, Ohio, long-established manufacturer of steel barrels, drums, and other specialties.

Acquisition of this plant gives Republic a direct outlet for the use of its steel in the manufacture of these products.

To Hunt Staff

Hunt Tool Company, Houston, Texas, announces the appointment of T. H. Salter, formerly district manager for Bethlehem Supply Company, to the Hunt sales staff. He will make his headquarters in Houston.

New research laboratories for Standard Oil

Construction of great new research laboratories for Standard Oil Company (Indiana) has been started according to Robert E. Wilson, chairman of the board, and A. W. Peake, president.

The new research plant will occupy property recently purchased by the company in Hammond, Indiana, near the Whiting refinery, with which it will be connected by pipe lines.

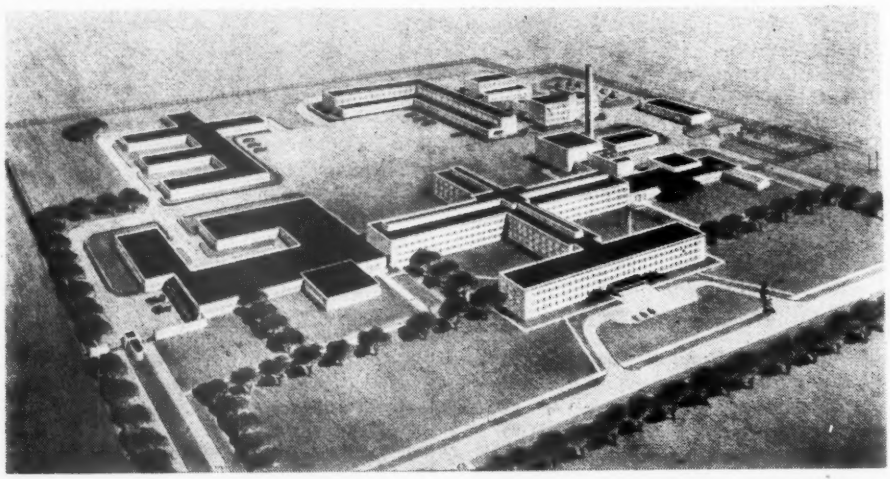
Without waiting for settled peace conditions Standard will proceed at once with erection of the main administration building, general laboratories, and three pilot-plant buildings. A cafeteria will be included. An engine laboratory, a greenhouse for insecticide work, additional pilot-plant buildings, and other research facilities are scheduled for subsequent construction.

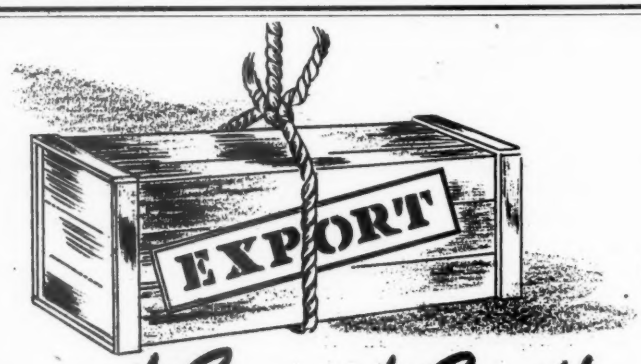
The principal buildings in the group will be of light gray brick, in the modern type of architecture. They will be air conditioned throughout and lighted in accordance with the best modern practice.

The basic unit will be a two-man laboratory. A "mock-up" of such a unit, complete with furnishings and lighting was built and tried out by research department personnel prior to final approval of the architect's plans. Partitions will be removable to permit easy alterations to one-man laboratories or larger areas as may be desired. The width of a one-man unit is to be 11 ft. As the main corridor will be off center, the laboratory lengths will be either 18 or 22 ft.

Architects of the project are Holabird and Root of Chicago.

Two hundred of the company's technologists and 260 other research workers are at present housed in old and somewhat cramped quarters scattered through the Whiting plant. The new facilities will not only provide room for these workers to expand their activities and operate more efficiently, but also make possible a considerable increase in the company's total research activities.





Expert Export Crating

SERVICE AT LOWER COST

With the war over we can provide our specialized crating service at greatly reduced prices.

Effective October 27 Lykes Brothers Steamship Company announces regular service from Houston to Venezuelan ports.

LEE CONSTRUCTION COMPANY

Specialists in preparing and crating equipment and supplies for export.

HOUSTON NEW ORLEANS

Holds new post

Appointment of Walter N. Fischer to the newly created position of assistant to the general sales manager is announced by R. G. LeTourneau, Inc., Peoria, Illinois.

W. N. Fischer

Fischer's promotion will entail assisting Gordon S. McKenty, general sales manager, in general office administration, as well as working closely with divisional sales managers in the coordination of the exclusive LeTourneau distributor sales organization.

Four years prior to his current appointment Fischer joined R. G. LeTourneau, Inc., as manager of its newly created war contracts division. In charge of inter-departmental coordination with the war sales structure, he directed in excess of $100,000,000 in war sales.

Fischer became well acquainted with heavy equipment dealers and contractors and their problems when for 3 years he was Chicago district manager for Schramm, Inc., compressor manufacturer. He had been previously affiliated with them for 12 years at their home offices in West Chester, Pennsylvania, and with their West Coast distributors.

Enlarging plant

Roots-Connersville Blower Corporation is making extensive improvements in its offices and the plant at Connersville, Indiana. WPB approval was given to an addition to house more adequately the engineering department.

This addition provides six more offices, a conference room, and a drafting room 15 by 55 ft., with ample north light.

Now that the wars are over and WPB restrictions are being lifted, it is planned to modernize the rest of the offices by installing an up-to-date heating and ventilating system throughout.

A new entrance lobby is also to be provided with a rearrangement of the central stairway, which will make the entire layout more convenient and attractive. Rest rooms are being enlarged and modernized, and it is hoped to have the work completed this year.

Roots-Connersville has had a minimum of reconversion problems, as this old company continued to build its prewar products, with certain modifications as to design, for the war effort. A heavy volume of orders was handled for the Navy on both direct and indirect contracts, and a large number was also produced for other branches.

Even as early as 1939, Roots-Connersville was working on specialized blower designs to be used as superchargers and scavengers on Navy subs, and many other types of vessels, both Navy and Maritime.

V-J DAY... That Did It!

We'll Be Back With You Soon

JUSTRITE

In fact . . . a limited supply of Justrite Safety Lanterns and Flashlights are available NOW for IMMEDIATE DELIVERY!

They're safety approved by Underwriters' Laboratories, U.S. Bureau of Mines and the Bureau of Marine Inspection.

Marine Type Safety Lantern with kick-out bulb sockets and spark-proofed guard standard. Absolutely safe in pump rooms of tankers.

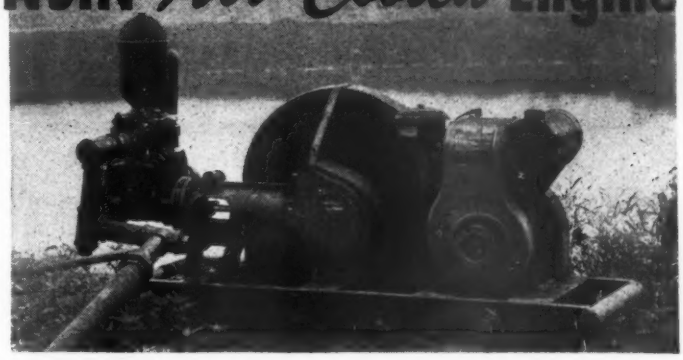
Handy-Safety Flashlight with 1500 candlepower from 3 standard cells. Fits the palm of the hand, on belt clip, or stands alone.

An All-Purpose Safety Lantern with a powerful beam. A movable guard base allows it to be focused from many angles.

Ask your Supplier about Justrite Safety Products.

JUSTRITE MANUFACTURING CO., 2063 N. Southport Ave., Dept. G-2, Chicago 14, Ill.

DOUBLE-DUTY ASSIGNMENT for WISCONSIN *Air-Cooled* Engine



The Wisconsin Air-Cooled Engine power application illustrated at the right is a typical example of how these fine engines serve the oil industry. If you have a power equipment problem . . . consult Harley Sales Co.

This 4-cycle, single cylinder Model AEH Wisconsin Air-Cooled Engine, driving a Goulds Pump, was first assigned the job of furnishing water to a well being drilled by Clyde Denman, an oil producer at Sedan, Kansas. Subsequently the outfit will be used to recover oil from the slush ponds and to transfer oil from swabbing tanks to field storage.

No matter what the assignment . . . Wisconsin Heavy-Duty Air-Cooled Engines are more than equal to the job . . . a good thing to remember in selecting dependable power for *your* equipment.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

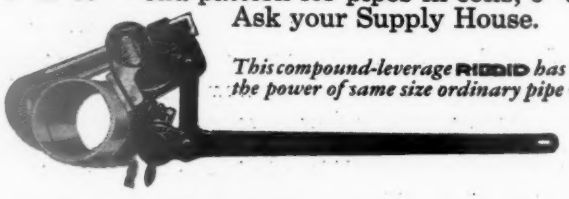
WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

Saves work...
Saves money

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free.
COPR 1937
THE RIDGE TOOL CO.
ELYRIA, O.
TRADE RIGID MARK PAT. 1727623

You do it with less effort with the
RIGID
and have no housing repair expense

● Pipe men everywhere prefer RIGID because of its efficient balance, easy-spinning adjustment nut, quick clean-action jaws, its handy pipe scale on hook-jaw, its powerful comfort-grip handle. It saves you work, makes it easier. But they like also that guaranteed housing ending all wrench housing expense. It gives you longer service, saves you money. Sizes 6" to 60"—end pattern for pipes in coils, 6" to 36." Ask your Supply House.



This compound-leverage RIGID has 14 times the power of same size ordinary pipe wrench.

RIGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

Form interesting partnership

Recently resigning his position as Los Angeles branch manager of The Foxboro Company, Virgil E. Schultz has formed a partnership with Rodolfo A. Martinez, under the name of Schultz and Martinez, in Mexico City. The new firm will specialize in the measurement and control of pressure, temperature, humidity, and flow, and will be exclusive representatives in Mexico of The Foxboro Company, Nurmberg Thermometer Company, Daniel Orifice Fitting Company, Vapor Recovery Systems, Inc., Meriam Manometer Company, and Southwestern Engineering Company (oil field equipment).

V. E. Schultz

Virgil Schultz has been long active in the oil and gas industry of California as a measurement and control engineer, and is well known for his activities in plant and refinery and in various scientific organizations in the Southern California district. He is a graduate of University of Southern California and first worked as a field operator for the Midway Gas Company, later transferring to Richfield Oil Corporation, where he was gas engineer in charge of measurement and control in the natural gasoline division. He began his association with Foxboro in 1931 and has been manager of the Los Angeles office for the last 6 years.

Schultz is a past director of the Southern California Meter Association, which he helped to organize, and has also been prominently identified with the California Natural Gasoline Association. His experience covers a wide range of metering devices in industry generally, but largely in petroleum refining operations, including thermal and catalytic cracking, alkylation, and polymerization plants.

R. A. Martinez

Rodolfo A. Martinez has represented Foxboro in Mexico for a number of years. He received his early education in El Paso, Texas, but later studied electrical engineering at the Escuela de Ingenieras Mecanicas Electricistas in Mexico City. He also took a post graduate course at that school in electrical machinery and apparatus. At various times he has handled assignments for Petroleos Mexicanos, Atlas Hornos S. A. and Cia Mexicano de Gas, and has been in close association with the Banco National Hipaticario, in connection with the design, installation and operation of water filtration plants.

The firm of Schultz and Martinez is the first of its kind in Mexico, offering to its patrons a unique combination of scientific background and industrial experience both in Mexico and the United States. Headquarters are at Avenida Madero 70, Mexico, D. F.

Allis-Chalmers appoints Van Cleaf

William C. Van Cleaf has been appointed director for industrial relations for the Allis-Chalmers Manufacturing Company, it is announced by Walter Geist, president.

Prior to his appointment, Van Cleaf served as assistant to Lee H. Hill, former head of industrial relations who resigned to become a publisher for the McGraw-Hill Publishing Company.

Van Cleaf entered Allis-Chalmers employment in 1912 as an electrical apprentice. After completion of his indenture, he worked in the service and erection department. Later, he was promoted to assistant foreman on the electrical test floor.

Appointed general supervisor of apprentice training, he was soon made company employment manager. With reorganization of the industrial relations division, Van Cleaf was made assistant to Hill.

Active in management and industrial relations organization, he is a member of the Society for the Advancement of Management, Industrial Relations Association of Wisconsin, American Management Association, Employer's Association, and the Allis-Chalmers Foreman's Club.

Odessa to have equipment building

Dunlap and Seaman of Houston, Texas, announce that they will begin construction in the near future of a building in Odessa, Texas, for oil field equipment manufacturers and their representatives.

This building, which will be modern in all respects, was designed by Harvin Moore, AIA Houston architect, and will be situated on the south side of the Odessa-Monahans Highway, within 12 blocks of the heart of town. It will provide adequate office and warehouse space for oil field specialty men and enable them to give their customers a complete 24-hour service. Twelve private offices with adjoining warehouse will be suitably situated on the ground floor. The building will be air-conditioned throughout.

All occupants will be entitled to the use of a 16-ft. by 24-ft., 8-in. fire and burglar-proof vault for the storage of their records and other valuables.

In order that each occupant may be able to display his products, he will be given a limited space in the reception room.

In addition to the private offices, there will be a large office space on the second floor for representatives who require only a desk, telephone, and stenographic service. The upper floor will be sound conditioned also. On this floor there will be a room which will serve as quarters for the night man, thus assuring 24-hour service.

An experienced oil field supply man will be manager of the building. He will be assisted by a warehouseman, stenographer, and night man, whose services will be available to the occupants of the building.

The building will be ready for occupancy in the first quarter of 1946.

Manager Chicago ESNA office

O. M. Hullinger has been appointed manager of the Chicago office of the Elastic Stop Nut Corporation of America, with headquarters at 20 North Wacker Drive, according to an announcement by John R. Munn, president of the company, in Union, New Jersey.

The outstanding job of positive fastening that the Elastic Stop Nut performed in military aircraft, ships, tanks, guns, and electronic devices during the war has opened many new fields for the Esna nut, it is announced, and the appointment of Hullinger to the important Chicago post is another step in the company's plans to continue its expanding uses in industry.

Elected director

Addison F. Vars, president Sterling Engine Company, Buffalo, New York, has announced the election of Lewis G. Harriman, president of The Manufactures and Traders Trust Company of Buffalo, to his board of directors.

"Mr. Harriman," said Vars, "has been closely associated with the development of the Sterling Engine Company for more than 20 years. His wide experience in the financial and industrial development of the Niagara Frontier eminently qualifies him to help guide our postwar expansion program now under way."

L. G. Harriman

Heads department

Arthur R. Tofte has been named manager of the advertising and public relations department, Allis-Chalmers Manufacturing Company, by William C. Johnson, vice president of the firm's general machinery division.

Tofte has been a member of the department since 1938. He succeeds George J. Callos, who resigned to become vice president and account executive for Klau-Van Pieterson-Dunlap Associates, Inc., Milwaukee advertising agency.

The new manager entered the department as copy chief. He became director of employe publications in 1942 and held that position until he was selected to head the department.

OIL FIELD

"Handyman"

BUCYRUS-ERIE BULLGRADER

Clearing and grading land for derrick or tank sites, building storage tank firewalls, maintaining access roads, digging and filling slush pits — there are plenty of oil field spots where it pays to have this speedy dirt-moving handyman, the Bucyrus-Erie Bullgrader.

With the hydraulic or cable-controlled Bullgrader you can take even the tough dirt-moving jobs in stride. You can use every bit of power the tractor produces because the Bullgrader is designed to maintain the tractor's original balance so that the full track-length is always on the ground — and working. Ask your International TracTracTor Distributor for full details.

1945

BUCYRUS ERIE

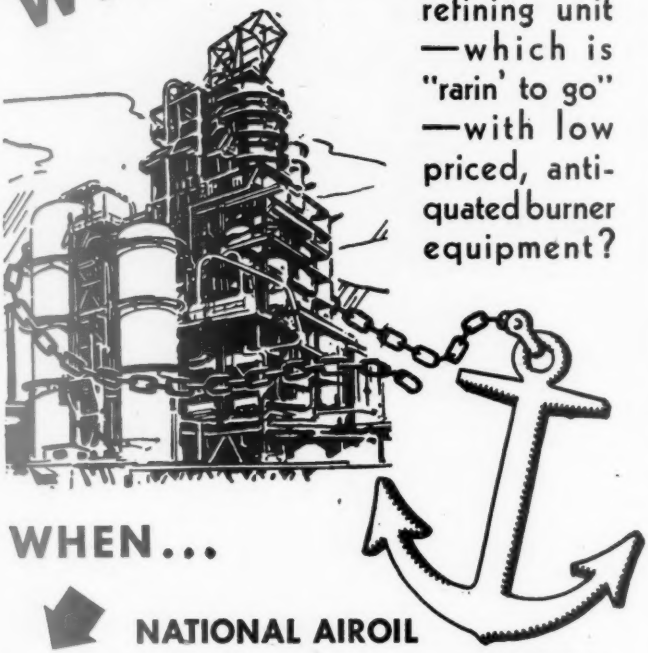
SOUTH MILWAUKEE, WISCONSIN

See Your

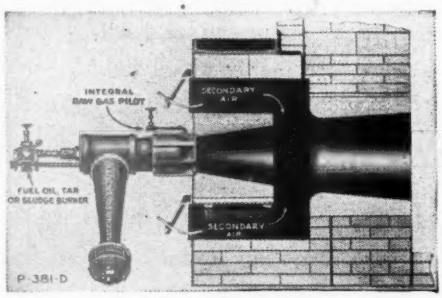
INTERNATIONAL TRACTRACTOR

DISTRIBUTOR

WHY? "anchor" a modern, multi-million dollar refining unit —which is "rarin' to go" —with low priced, anti-quated burner equipment?



WHEN... NATIONAL AIROIL PATENTED TANDEM BLOCK COMBUSTION UNITS MEAN...



During the past 33 years we have helped many leading refineries in the United States, Canada and other parts of the world solve their combustion problems by furnishing them with National Airoil engineered fuel oil or gas burning equipment.

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More BARRELS PER DAY
More DAYS PER RUN
More PRODUCT PER FUEL DOLLAR

NATIONAL AIROIL BURNER COMPANY, INCORPORATED
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OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS
EXPLOSION DOORS • ACCESS DOORS • AIR DOORS
BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

To South American post

John F. Dodge, since 1929 head of the Division of Petroleum Engineering at the University of Southern California and well known consulting petroleum engineer, has become associated with Pantepec Oil Company of Venezuela, C. A., as vice president and manager with headquarters in Caracas. He will retain his association with the University of Southern California. Prior to his association with the university, Professor Dodge was for many years petroleum engineer with the Kern Trading and Oil Company, Pacific Oil Company, and Standard Oil Company of California.

John Dodge

Professor Dodge has traveled extensively in foreign fields having visited and studied the oil fields in Burma, Sumatra, and Java as well as Venezuelan and North American fields. He has served as consultant for many California oil companies and for many years has been consulting petroleum engineer and geologist to the Division of Oil and Gas and the Railroad Commission of the State of California. In the latter capacity he was author of the recent publication of the commission on the gas reserves of the state.

He has been a member and active in the work of the American Institute of Mining and Metallurgical Engineers, American Association of Petroleum Geologists, and Production Division of the American Petroleum Institute, holding important committee posts and contributing papers on various topics at the meetings of these societies.

Professor Dodge will establish a home in Caracas in the near future with his wife and family.

Add to engineering staff

In accordance with its policy to provide personalized engineering service to all users of welding, The Lincoln Electric Company, Cleveland, Ohio, announces the appointment of the following district office representatives who have been added to the firm's engineering staff.

John A. Smithers was named welding engineer in the Detroit area. He received his academic training at Elkhart, Indiana, public schools, and attended the University of Michigan, Ann Arbor, Michigan, for 4 years. He also studied at Aero Engineering, Pratt and Whitney Aircraft School of the Ford Motor Company, had post-graduate study in metallurgy at the University of Michigan's research laboratories, and completed a business course of the Alexander Hamilton Institute.

W. L. Herbst has been appointed welding engineer at Chattanooga, Tennessee, office. Shortly after receiving his college training at Miami University, Oxford, Ohio, he joined The Lincoln Electric Company at Cleveland, as clerk in the punch press department. During his 15 years' association with the company, he has held responsible positions in the time study work and as foreman of the assembly and test department.

Harold H. House has been appointed welding engineer in the Moline, Illinois, area. House became interested in welding in 1928 when he was connected with a road paving company repairing their equipment. After completing a night course in welding procedures he joined the Lonken-Galamba Corporation, as a production welder on piping, tanks and other steel products, advancing to maintenance welder involving all types of metals.

Later he was associated with the Kansas City Structural Steel Company, where during the latter two years with the company, he was instructor in welding and in charge of screening new employes, testing electrodes and finish inspecting.

During the last 2 years House taught welding students at Argentine High School, Kansas City, Missouri, the course including a study of metals.

L. B. Wallner has been appointed district welding engineer at Duluth, Minnesota, replacing I. R. Bartter who was promoted to welding engineer at Lincoln's Grand Rapids, Michigan, office. For the last 5 years, Wallner held the post of superintendent for Zenith Dredge Shipbuilding Company, Duluth, Minnesota.

C. M. Burnett has been assigned the position of welding en-

gineer in the Boston, Massachusetts, area. Burnett received his schooling at St. Paul, Minnesota, and became interested in welding in 1937 when he enrolled in the apprentice welding course. Upon graduating, he was engaged in welding of industrial products and attended several courses on production welding and welded design, later joining the American Welding Society.

Entering the construction welding field, Burnett worked on a number of projects for such companies as Chicago Bridge, Colonial Beacon Oil, E. B. Badger Engineering, and The Walworth Company. Soon after, he was engaged in the welding of turbines. This position dealt mostly with experimental work and the training of apprentice welders.

D. F. Austin moves up

Benjamin F. Fairless, president, announces the election of David F. Austin as vice president, sales, United States Steel Corporation of Delaware.

Austin has been acting vice president since June 20, 1945, during which time he continued as vice president in charge of sales, Carnegie-Illinois Steel Corporation.

D. F. Austin

He began his career with United States Steel as an office boy in the Corporation's New York office late in 1918, and served in various capacities with the real estate department of the Carnegie Steel Company until 1927 when he was transferred to the sales department, entering the company's sales school.

After working as a salesman in four different sales territories, he was advanced to assistant district manager of sales, Cincinnati, following which he served successsively as district manager of sales in Cincinnati, Pittsburgh, and Chicago. Austin was elected January 1, 1938, as vice president in charge of sales, Carnegie-Illinois Steel Corporation, in which capacity he served until his current advancement.

From January, 1942, until July, 1943, Austin served with the War Production Board, becoming successively assistant director, deputy director, and acting director of the board's steel division.

W. A. Davis to LeBus Company

W. A. (Red) Davis, formerly district sales manager for Baker Oil Tools, Inc., at Houston, Texas, recently resigned to become sales manager for the F. L. LeBus Company and LeBus Rotary Tool Works, Longview, Texas.

The LeBus Company recently announced its entry into the commercial drop forging and job machining fields. Reconversion of a drop forging plant that has heretofore been in 100 per cent war production and which has a capacity of 500,000 forgings per month has been completed. The new machine plant and die shop is now available for job machining and sub contract manufacturing. The LeBus Rotary Tool Works will continue to make fishing tools.

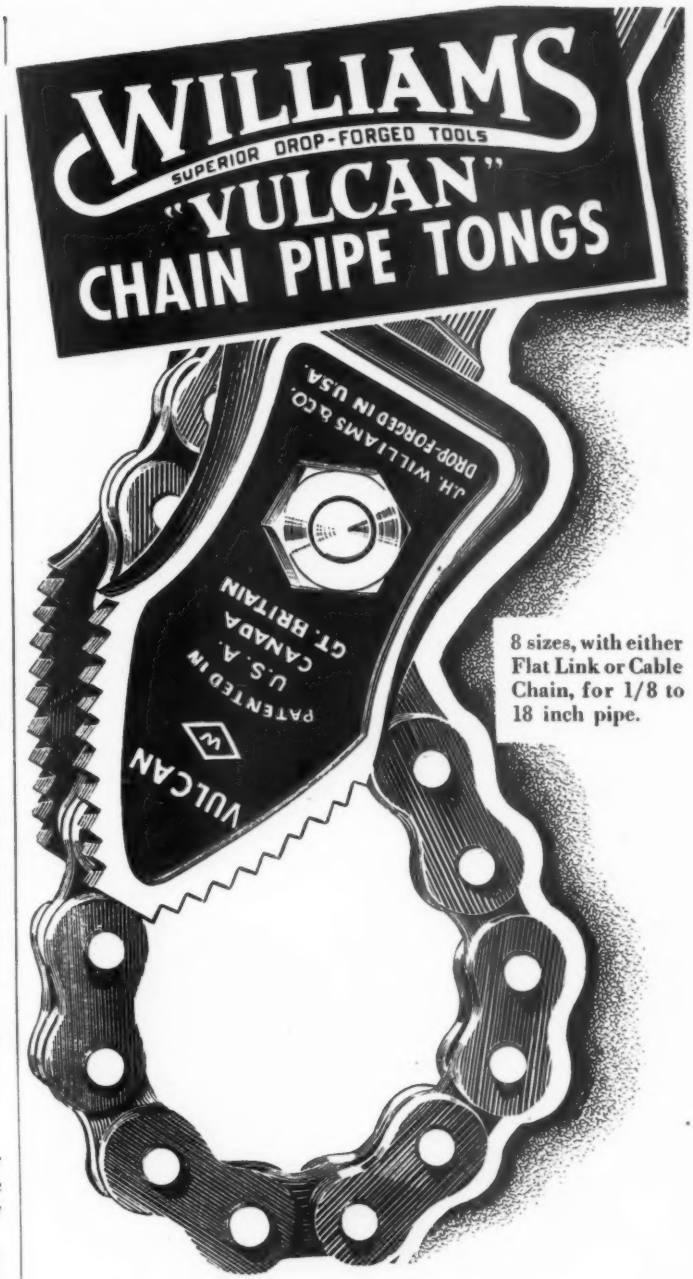
W. A. Davis

Davis is a member of the Houston Nomads and the Houston Technical Club.

Thermoid district manager

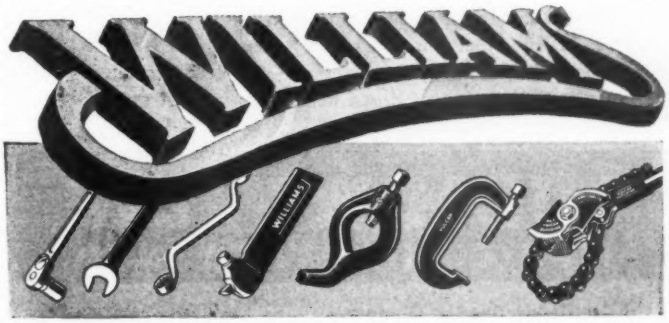
Thermoid Company, Trenton, New Jersey, announces the appointment of Walter B. Chick as a district manager of its industrial rubber products division in the Northwest Pacific Coast area. He will make his headquarters at Thermoid's San Francisco branch office at 895 O'Farrell Street.

Chick has been a member of the Thermoid organization for more than 10 years. Before assuming his new duties, he served as sales-service manager of the company's automotive replacement division for 2 years. For 8 years prior to this, Chick was San Francisco district manager of Thermoid's automotive replacement division.



For almost half a century "Vulcan" has been the favorite oil field tong because of its unique ability to "take it." Chains are *proof-tested* and *certified.* Jaws and Handle are tough drop-forgings. Through-bolt is extra heavy and threaded U. S. Standard so nut can be readily replaced. Write for literature, or refer to our advertisement in Composite Catalog.

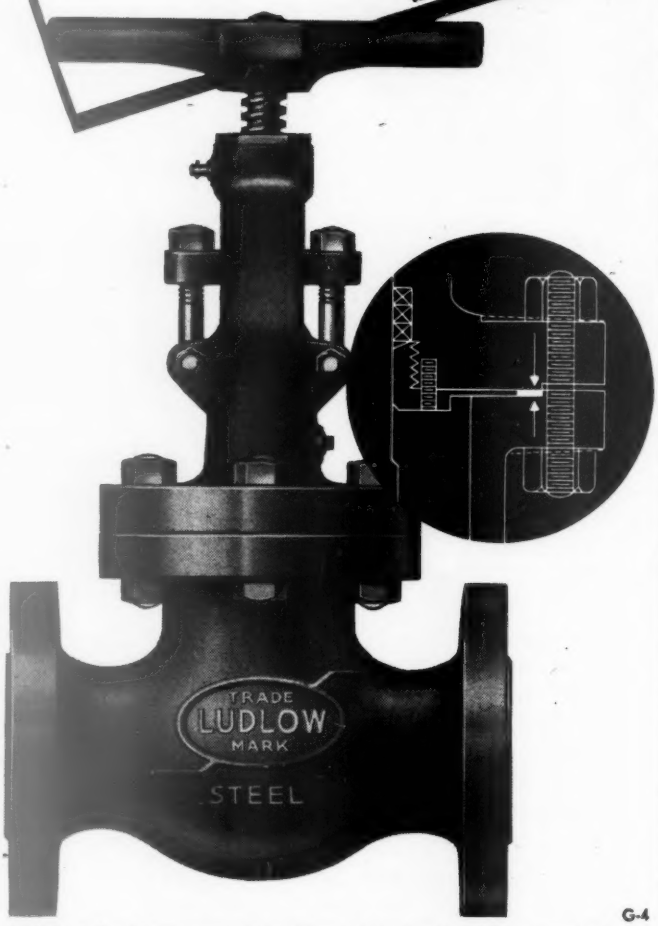
J. H. WILLIAMS & CO., BUFFALO 7, N. Y.



"Swap a pencil for a wrench and you'll get ideas on bolting a bonnet joint."

Right! That's why LUDLOW STEEL GLOBE VALVES have:

- Throat flange bolting spaced to prevent distortion when bolting joint.
- Liberal gasket compression maintained by method of throat flange bolting.
- Through-bolts with ample wrench clearance.
- Throat flange bolts are extra strong, high tensile steel, continuously threaded.



G-4

A tight joint is but one of the "musts" in Ludlow Cast Steel Globe Valves. All the other requisites, everything you expect in a valve, are embodied in Ludlow Construction — the result not only of excellence in design, but of practical ideas gained in everyday use. . . . Write today for catalogs.

The LUDLOW VALVE SINCE 1866
MFG·CO·INC·TROY·N·Y·

Mid-Continent Supply Company Fort Worth, Texas

To new post with National Tube

Andrew C. Temmel, veteran Texas and Oklahoma oil field service engineer of National Tube Company, has been named manager of engineering sales service for this United States Steel subsidiary. His headquarters will be in Pittsburgh, Pennsylvania.

A. C. Temmel

Last stationed at Houston, Texas, and previously in Fort Worth, Texas, and Tulsa, Oklahoma, Temmel has been serving National Tube as a field engineer in the Southwest area since 1933. He started with National Tube in 1924 after graduating from Carnegie Institute of Technology.

Born in Pittsburgh in 1900, Temmel comes from a line of National Tube employes since both his father and uncle spent a lifetime of service with the organization.

From 1929 to 1933, he was head of the company's field engineering department in Pittsburgh, after which he specialized entirely in oil country tubular engineering in the Southwest.

Waukesha elects Frame

The board of directors of the Waukesha Motor Company has announced that Walter Frame, president of the Waukesha National Bank and for many years a leader in business, management, and financial circles, has been elected a director of the company. Frame fills the board position left by the late Harvey J. Frame.

Also announced was the election of C. P. Ross, a director and the treasurer of the firm and formerly assistant secretary, to the post of secretary. Louis W. Youker, present assistant treasurer, succeeds Ross as assistant secretary. Both of these men have been with the company since its early years.

Bucyrus-Erie distributor

Recently appointed distributor for Bucyrus-Erie ⅜- to 2½-yard shovels, draglines, and cranes, A. E. Hudson Company of Peoria, Illinois, will handle this well known line of excavating equipment in central Illinois. Its territory includes the region south of, and including, the counties of Henderson, Warren, Knox, Stark, Bureau, LaSalle, Grundy, Iroquois and north of, and including, Hancock, Schuyler, Cass, Menard, Logan, Macon, Moultrie, Cumberland, and Clark counties.

The business policy of A. E. Hudson Company has always been one of supporting all sales with outstanding service. The company places its efficient organization at the disposal of central Illinois contractors who want help on their dirt-moving problems. Headquarters of the company are at the foot of Morton Street, Peoria 3. A. E. Hudson Company also handles the complete line of Bucyrus-Erie tractor equipment—bull-graders, bulldozers, dozer-shovels, and scrapers.

Bucyrus-Erie customers in southern Illinois will continue to be served by the Geo. F. Smith Company of St. Louis, those in northeastern Illinois by Great Lakes Supply Corporation, Chicago, and those in Mercer, Henry, Rock Island, and Whiteside counties by H. Alter Company, Davenport, Iowa. All Illinois distributors for Bucyrus-Erie excavators work with the cooperation of the Bucyrus-Erie district office at 105 West Adams Street, Chicago.

Distributor for steam specialties

Harry E. Clark and Company, Shell Building, Houston, Texas, have been appointed by Strong, Carlisle and Hammond Company, Cleveland, Ohio, as distributors for its full line of steam specialties, including the new "Hi-Cap" inverted bucket traps, open bucket traps, strainers, and pressure regulators.

Harry E. Clark has been a prominent manufacturer's representative in Houston since 1938, and prior to that time he owned and operated refineries at Laredo and Corpus Christi, Texas. His experience has given him an intimate knowledge of all oil field and refinery problems.

Now associated with Harry E. Clark and Company, is J. Doug Toole, who has been sales engineer with Norvell-Wilder Supply Company since his graduation from Texas A&M Col-

lege in 1936, except for one year with Lummus Company in 1942-43 in constructing complete refinery units in the Houston area.

Harry E. Clark and Company plan to establish a sales and service branch in Dallas soon.

Hilliard in charge sales

Election of Thomas J. Hilliard as vice president in charge of sales of Carnegie-Illinois Steel Corporation, effective October 1, was announced in Pittsburgh, Pennsylvania, by J. L. Perry, president of this United States Steel subsidiary. Hilliard has been general manager of sales since 1938. He is succeeded by J. Douglas Darby, who has been manager of sales for the company in Philadelphia since 1939.

T. J. Hilliard

Two other sales department staff changes announced are Paul Selby as assistant general manager of sales and Wesley C. Bobbitt as manager of sales in Philadelphia.

Hilliard has been with Carnegie-Illinois since 1936. He was in the oil business from 1919 to 1931 and later became executive vice-president of Standard Steel Spring Company.

Darby was assistant to vice president of sales of Alan Wood Steel Company prior to joining Carnegie-Illinois 6 years ago. Selby has been with the company since 1907. Bobbitt began as a sales engineer in the Philadelphia office in 1936.

Ideco appoints vice presidents

Three vice presidents have been appointed for the Ideco sales organization, O. M. Havekotte, president of International Derrick and Equipment Company, announces.

Ferguson Barnes has been promoted to vice president in charge of sales. H. L. Putnam enters the Ideco sales organization as vice president, Mid-Continent direct sales. G. W. Walton is promoted to vice president, machinery sales.

Barnes has served for 30 years in engineering and sales for

H. L. Putnam

G. W. Walton

Ferguson Barnes

Ideco and other companies in the oil field and construction industries. A graduate of Kentucky States University (his home state) he worked in California, the Mid-Continent, and the East.

H. L. "Put" Putnam will supervise all direct sales activities of Ideco in the Mid-Continent and Rocky Mountain region, including both equipment and supply store sales.

Putnam has just retired with a Colonel's rank, having completed more than 3 years' service in the U. S. Army Air Forces. Before entering the Army he was associated for 19 years with National Supply Company.

G. W. "Jack" Walton, formerly manager of Ideco drilling machinery sales, will continue to supervise the Ideco machinery department. Walton's business career has been devoted to oil field equipment. He was associated with the National Supply Company in this country and in London, England, with Wilson-Snyder Manufacturing Company, with Emsco as vice president and sales manager, and with Unit Rig and Equipment Company as sales manager.

Barnes will be in the company's head office in Columbus, Ohio, and Putnam and Walton will be in Ideco's Mid-Continent headquarters at Dallas, Texas.

The International Derrick and Equipment Company, whose trademark is IDECO, is one of the Dresser Industries.

Precision Threads Quickly Easily

with self-contained semi-automatic

RIDGID No. 65R

• Save yourself time and effort in threading 1", 1¼", 1½" and 2" pipe. This rugged steel-and-malleable 65R gives you precision threads faster and with less effort than you've thought possible. You like the 10 second setting to size with one set of chasers that stay in the die stock (no extra dies to bother with) and the instant-setting foolproof workholder. Precision cut high-speed steel chasers and factory testing of every threader assure you of clean perfect threads, smooth faultless operation. For quicker easier threading buy the 65R at your Supply House.

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WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

BUILT FOR TOUGH GOING

HOBBS

OIL FIELD SPECIAL

The HOBBS (OFS) OIL FIELD SPECIAL TRAILER is built for use behind truck in the oil field where an Oil Field Body is on the truck. This model is built for rough service and is ideal for general utility work around oil fields.

Quantity production has scaled the price down so that the HOBBS OFS Trailer can meet most any price competition and still hold the advantage of being a HOBBS-built, pole type trailer.

Order NOW for Early Delivery
Write for Details

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FORT WORTH ★ HOUSTON ★ DALLAS
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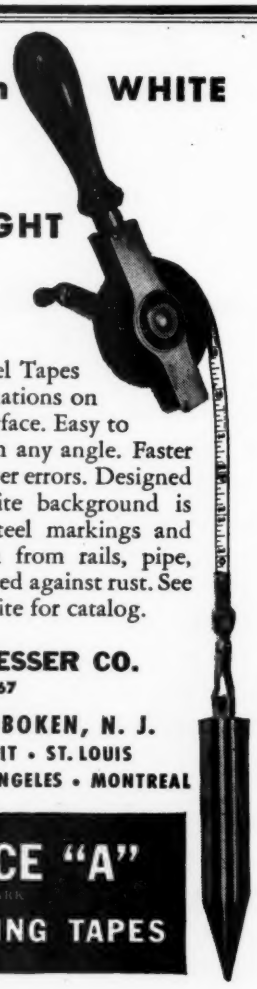
BLACK on WHITE for BETTER SIGHT



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STEEL GAUGING TAPES

Book Reviews

● **Oil Directory of Colombia and Handbook on Colombian Oil (1945).** *Prepared and published by E. Ospina-Racines, Apartado 27-23, Bogota, Colombia.*

This directory and handbook, which is now ready for mailing, contains considerable information that should be of interest and value to members of the petroleum industry in the United States, as well as to the oilmen in other areas of the world.

The thoroughness of the volume's coverage is indicated by the following chapter headings: 1. Oil companies in Colombia, alphabetical list and affiliation; exploration services; 140 enterprises. 2. Majors: Parent companies; key personnel; post and title; mail and cable addresses; office location in Bogota. 3. Pipe line operators. 4. Exploration services. 5. Oil royalties. 6. Government of Colombia: (1) Ministry of Petroleum; (2) Industrial Development Institute. 7. Independent oil companies in Colombia. 8. Oil companies affiliated to majors. 9. Oil and Mining Federation: Officers; addresses. 10. Colombian Petroleum Institute: Members, company, profession. 11. Members of the AAPG in Colombia. 12. Oil industry professionals and services: Engineers, lawyers, accountants, surgeons, translation and stenographic services.

These 12 chapters complete the Oil Directory Section of the volume. Chapters in the Handbook Section contain the following information: 13. Prospective oil land of Colombia, index map. 14. Topographic map of Colombia (X-Section Llanos-Pacific). 15. Time element in acquiring and testing concession; chart. 16. Oil property index map of Colombia. 17. Exploration and development commitments of the majors. 18. Concessions granted to date; year, area, date granted. 19. Concessions surrendered or canceled. 20. Concessions in force by majors. 21. Wildcats drilled in Colombia, 1907-31. 22. Wildcats and wells drilled in Colombia, 1931-45. 23. Royalties and tax payments of the oil industry to Government. 24. Oil exploration funds and commerce. 25. Cost of finding oil in Colombia. 26. Colombian oil patents issued 1940-44.

● **Oil and Petroleum Year Book for 1945. Compiled by Walter E. Skinner, 20, Copthall Ave., London, E. C. 2, England.** *Pages, 190. Price, 12s, 6d.*

Skinner's Oil and Petroleum Year Book for 1945, just published, contains the most accurate and complete information respecting oil companies that is possible to obtain. The volume gives complete particulars of 541 companies engaged in all branches of the industry. Accurate petroleum production figures for all countries in 1944 were not available at the time of publication due to war conditions. Skinner takes into account recent trends in the oil industry, including the oil pacts, new fields opened in various countries heretofore nonproducers and record-breaking output records of petroleum in his newest compilation. A source of information to oil men for 34 years, the Oil and Petroleum Year Book for 1945 again brings thorough and complete oil company facts to the industry.

Ballagh surveys oil fields

Jack Ballagh, secretary and general sales manager of the Patterson-Ballagh Corporation, is making a 5-weeks' tour of the oil fields of Texas, Louisiana, and Oklahoma, making his headquarters at the Patterson-Ballagh offices and warehouses in Houston.

Working with the district manager, Jack Magoffin, Ballagh is taking the first opportunity since early war years to call on the trade and get a first hand picture of present field conditions and developments.

For many years a producer of oil field specialties equipment, featuring the use of PBX synthetic rubber for the purpose of protecting drilling equipment and making the drilling job easier, he is studying ways and means of adding new and improved items to the well known Patterson-Ballagh line. He reports that he has gained many ideas for new developments in the coming postwar production period.

C. F. Succop passes

Clarence F. Succop, president and director of American Roller Bearing Company, Melwood Street, Pittsburgh, Pennsylvania, died October 4, after almost a year's illness. A member of American Petroleum Institute and the Anti-Friction Bearing Society, Succop was widely known in these industries.

C. F. Succop

Born in Butler, Pennsylvania, in 1888, he graduated in electrical engineering from Union College, Schenectady, New York. He was connected with the General Electric and Western Electric companies until shortly before founding the American Roller Bearing Company in 1914, from the nucleus of another company then manufacturing automotive parts.

Succop is survived by his widow, Clementine G. Succop, a son, William G. Succop, an official of the company, four grandchildren, and three brothers, Walter A., Joseph H., and Frank W. Succop. Another son, Lt. Larry Succop, a fighter pilot in the 49th Fighter Squadron in New Guinea, was killed in action October, 1943.

Oakite Victory Conferences

Highlighting each of the 1945 Victory Conferences of the Oakite organization, held in New York and Chicago during October, was a vast exchange of technical information on cleaning, descaling, derusting, degreasing, and related operations, particularly as applied to peacetime manufacture of civilian products. In addition to the entire field forces of more than 140 Oakite technical service representatives, these conferences were attended by the staffs of the mechanical engineering, chemical and research laboratories of Oakite Products, Inc.

The various discussions revealed many low-cost, time-saving techniques for handling such maintenance tasks as descaling diesel cooling systems, cleaning lube oil and jacket water coolers, degreasing parts before repair and overhaul, cleaning intercoolers or air compressors, cleaning air compressor valves, and many other important cleaning and related operations.

Of particular interest was the announcement of the newly developed Oakite vapor cleaning unit, which will soon be available to industry. Capable of generating steam pressure up to 200 lb. within 1 to 2 min. after starting from cold, this unit discharges 60 to 90 gal. of steam cleaning solution per hour at the desired steam pressure up to 200 lb. Further continuous operation of two steam guns at the same time is possible with this unit.

Bass to new Dresser post

Roy A. Bass has recently been appointed director of distribution of Dresser Industries, Inc., Cleveland, Ohio, a new post. Dresser Industries is the parent organization of 14 companies serving oil, gas, and industrial markets and has 22 plants throughout the country.

Roy Bass

In this position he will be responsible for the national program of Dresser and its member companies in the establishment and expansion of distribution in industrial centers.

An engineering graduate of Cornell, Bass has been active in both sales and marketing for a number of years. Before assuming his present duties, he was Buffalo district sales manager for Ross Heater and Manufacturing Company, Inc., Buffalo, New York, with whom he has been connected for the last 11 years.

ELECTRICITY

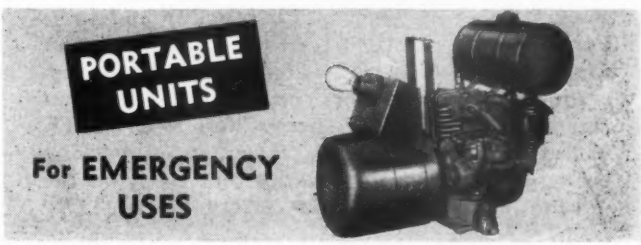
WHERE You Want It
WHEN You Want It

Model Shown: 6.25 KVA. 4-cylinder, gasoline. Water cooled. Push-button starter.

U. S. Electric Plants are engineered by men familiar with oil-field operating problems . . . and backed by over 50 years of manufacturing experience. Operating panel and instruments under weather-proof housing. Compact. Skids make handling easy. Complete line includes Gasoline units from 500 watts to 75 KW; Diesel units from 2 to 75 KW. AC and DC.

Model Shown: 1500 watts, 115 volts, AC. Automatic control. Single cylinder, air-cooled engine.

U. S. Automatic Electric Plants start when the first light is turned on . . . stop when the last light is turned off. Manual control units also available. Can be supplied for operation on natural gas. Simple, trouble-free design and rugged construction have made these units famous for reliability. 800 and 1500 watt models are the most popular for camp lighting.



Unit Shown: 600 watts, DC.

Wherever a breakdown occurs, get things going again in a hurry . . . no need to work in the dark if this compact 67-pound electric plant is kept handy! Other Portable units up to 15 KW. Write for literature.

ARMY E NAVY

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C. A. McDade Co., 6526 Hamilton Ave., Pittsburgh 6, Penn.
Midland Implement Co., Box 2113, Billings, Mont. and Great Falls.

U.S. ELECTRIC PLANTS
GASOLINE • DIESEL

RODPAK is the patented, guaranteed, non-friction, floating seal, long-lasting, moderate cost, highly efficient metallic packing. It's made when you want it, how you want it to fit your specifications. Simple and speedy to install; swift to fit, slow to wear. Guaranteed for one year, its average service life is much longer.

Pack up your troubles with RODPAK. It's definitely superior for Compressors (all types), Steam Units (Saturated), Oil Pumps, Acid Pumps, Water Pumps (hot and cold), Hydraulic Units (high or low pressure), Asphalt Pumps, Valve Stems, Logging and Sawmill Units, Marine Units including Main and Auxiliary Feed Pumps, Fuel Oil Service Pumps, Fuel Oil Transfer Pumps, Fire and Bilge Pumps, Brine Pumps, Sanitary Pumps, Generator Engines, both rotary and reciprocating type Refrigeration Units, Telemotors and Steering Gear Rams and many other units having RODS, SHAFTS, LINERS, PLUNGERS. If you want packing promptly, if you want packing that keeps on the job for years . . . **"PACK UP YOUR TROUBLES"**

Specify **RODPAK**
METALLIC PACKING
for rods, shafts, inside & outside packed plungers

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Bill Hay, who directs Union Oil Company's pipe line operations, is one of the oil industry's most rabid photographic bugs. This is probably due to long association with Doc Curtis, the Brea medic who fell a victim of streptococcus cameratis many years ago. It is perhaps beside the point, but Doc has been peering into the dark interiors of oil men for the past 20 years and still can't find any congenital abnormality that would account for their being in the oil business. That, however, is just an aside, what we really started out to say was that before snapshooting a home, Bill Hay always proceeds to dig up the front lawn. He has done that ever since Doc told him it was a good idea to break up the foreground.

●

And that brings us to Stan Clitherto, the General Petroleum fire protection expert, whose favorite sport is yachting. There may be no truth in the story, but we have been told that Stan took up yatching to avoid tire trouble. In any case he can now use the word "yawl" without being mistaken for a southerner.

●

Olen Lane, Continental's western land chief, is addicted to four sports—three cushion billiards and goose hunting (count them for yourself). By a peculiar coincidence he once shot the biggest honker that was ever bagged, on the very same day that a lovely swan disappeared from the nearby municipal park. By a peculiar coincidence, also, when he tried to pick up the goose by the head, its neck stretched so abominably he couldn't get the body off the ground. It may, however, be consoling to Olen to know that we recently went on a hunting trip, too—all we bagged was our pants.

●

In his spare moments, which are few, Neil Durkee of Ralph M. Parsons Company, is addicted to a game that remotely resembles golf. It is said that the clubhouse on the public course up in Edmonton, Canada, was built on one of his divots. By the same token, the good looking secretary of a certain oil executive who shall be nameless recently took up the Caledonian pastime and every week since she started has been going round in less and less.

●

Tom Taggart, the fighting Irishman, is feeling right at home up in San Francisco with all his fellow countrymen. Tom has a very soft spot in his heart for the Ould Sod and has always contended half the lies that are told about Ireland are not true. When we bumped into him in the northern metropolis a few days ago, he beamed, "By golly, if I didn't know you and somebody described you to me, I wouldn't believe it." Now we are all in a dither trying to determine whether we were being complimented or maligned.

●

It's good news that Phil Magruder has been appointed head of General Petroleum's manufacturing department and a director to boot. Phil is one of the organizers of the California Natural Gasoline Association and has long been held in high repute by the natural gas and gasoline experts. Don't know whether or not he is still addicted, but he used to play a mean game of tennis, and indeed, the biggest scare he ever had in his long and checkered career was when he heard his neighbor hammering nails one day just after he had borrowed his new racket.

●

Julius Dietzel was out at the Production Pioneers' party checking up on Pete Connor's barbecuing ability. Julius has a barbecue pit in his own backyard at Montebello that by all accounts is a honey. When he isn't away at a shrine convention, he likes nothing better than to have a few friends around for a tender steak—the few friends like nothing better either. During the war, of course, the best he could do was to have a tender steak around for a few friends. Which reminds us, Dick Guiberson is now so far recovered that he will soon be able to eat the things that don't agree with him again.

Don Weaver is a great admirer of pedigreed hunting dogs. He likes the retrievers best because he was always taught that it is rude to point, and besides the retrievers are adjustable—you can let them out at night and take them in again in the morning.

●

Jack Marsh, one of Martin Decker's new engineers, worked on the Canol pipe line up in Canada and Alaska for a year and a half. He tells us that the Canadian backwoodsmen are the most inarticulate people in the world. Some of them only open their traps once each winter.

●

Speaking of Alaska, Russ Havenstrite, who has also adventured in the Tundra, is one of the industry's leading polo players. This is a variation of hockey in which the players use ponies instead of skates and time is reckoned in chukkers. All joking aside, however, Russ has one of the finest strings of polo ponies in the West. Don't look now, but George Trembley appears to be headed in the same direction. George has a fine string of polo shirts and a charley horse.

●

Glenn Merkley, the National Supplier, has picked up a smattering of archaeology in his trundling around the local scene. He is convinced, for instance, that Torrance is one of the oldest towns in the world, and to prove it he quotes from somewhere in the book of Genesis, as follows and to wit: "The lightning flashed, the thunder roared, and the rain came down in Torrance."

●

With which few remarks we conclude. Remember, in the oil business a hypocrite is a guy who starts working on graveyard tour with a smile on his face.

Beaumont Iron Works sold

The American Locomotive Company has purchased the Beaumont Iron Works Company of Beaumont, Texas, effective October 1, it has been announced by D. W. Fraser, president of the locomotive concern. The sale is subject to the approval of Beaumont stockholders.

This step gives the locomotive builder 7 manufacturing plants in the United States and adds substantially to the company's facilities for servicing the oil industry in the southwest, Fraser pointed out. The line of oil well drilling and production equipment now manufactured by the Beaumont company will be continued by American Locomotive Company, which will install added facilities at Beaumont for the servicing of its installations in this district. The locomotive company is one of the world's largest builders of heat exchangers, pressure vessels, and prefabricated pipe.

The Jones and Laughlin Supply Company, a subsidiary of the Jones and Laughlin Steel Company, it was announced, will continue as exclusive distributor of the Beaumont line of oil well drilling and production equipment for both domestic and export trade.

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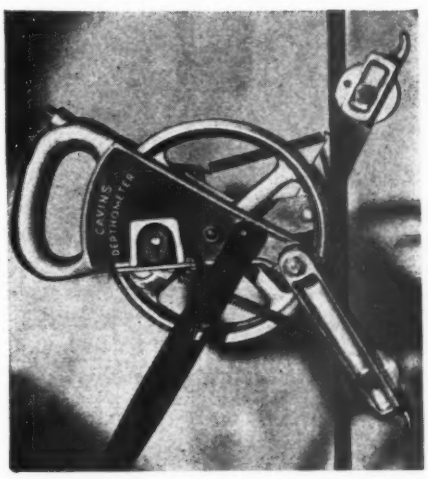

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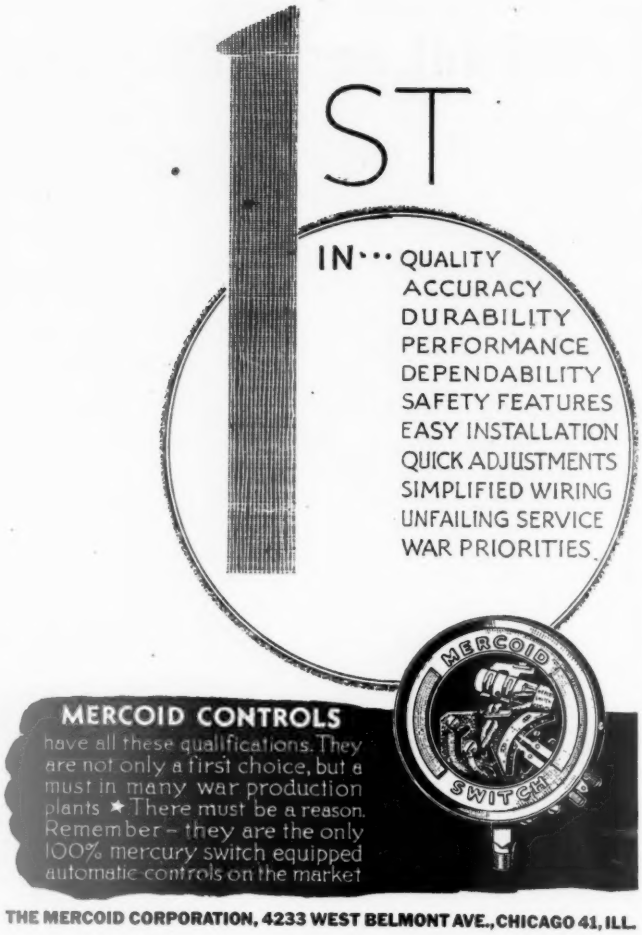

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Twin Disc vice president

The election of N. F. Adamson as vice president in charge of sales and engineering of the Twin Disc Clutch Company, Racine, Wisconsin, has been announced by P. H. Batten, president of the company.

Batten also announced the following additional personnel changes:

E. C. Billings has been named sales manager of the Racine division.

Roger G. DeLong has been appointed sales manager of the hydraulic division, with headquarters at the company's Rockford, Illinois, plant.

G. W. Buelke has been appointed chief engineer of the Racine division.

N. F. Adamson

The purpose of the new appointments, according to Batten, is to provide a closer coordination of engineering, sales and service activities in the Racine and Rockford divisions, and to make closer contact possible between the main offices and users of Twin Disc clutches and hydraulic drives, supplementing the regular contacts made by personnel of the company's district offices.

Adamson, who has been general sales manager for the last 2 years, has been associated with the Twin Disc Cutch Company for more than two decades. He was chief engineer for many years, and prior to that time worked with the sales and engineering departments.

Lightbourn forms own company

Walter S. Lightbourn, who has been vice president and sales manager of The Waukesha Sales and Service Company, has resigned to form his own company, The Lightbourn Equipment Company. The new company has its offices and warehouse in the second unit of the Santa Fe Building at Dallas, Texas. A line of oilfield specialties is handled including winches, pumps, engines, slush pump liners, light plants, drives, and electric equipment. Specialized engineering and design work is available on various field units and installations, it is announced.

Lightbourn was graduated from Georgia Tech in 1928 as a mechanical engineer.

He was employed by Oil Well Supply Company from 1930 to 1934 in the capacity of field service engineer and salesman. In 1934 he joined Portable Rig Company as manager of the Dallas branch, and was elevated to district manager in 1936. He was appointed sales manager of the company in 1941 and moved to the main office and plant at Houston, Texas.

Portable Rig Company divided its activities in 1944, selling the rig manufacturing facilities to the Texas Iron Works, Inc., and retaining the distributorship in Texas of the Waukesha Motor Company line of engines and parts. A new concern was formed, The Waukesha Sales and Service Company and Lightbourn was elected vice president and sales manager, which position he held until September 1, 1945, when he resigned to enter business for himself.

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To J & L export department

F. A. Street has been transferred to Jones and Laughlin Supply Company's New York export department, where he will be active in a sales capacity under Park B. Turner, manager of this department, located at 230 Park Avenue, New York City 17, New York.

F. A. Street

Street has a background of supply experience that well qualifies him for this important position.

In 1935 he joined the Frick-Reid Supply Corporation as a storeman at Ada, Oklahoma, moving to the Oklahoma City, Oklahoma, store in 1937, and then to the Anson, Texas, store in 1938. In 1941 he was made manager of the Wichita Falls, Texas, store. He devoted his time thereafter in a managerial and sales capacity until he enlisted in the U. S. Army in 1942. He was placed in the Ordnance Department of the 3rd Army and was graduated as a second lieutenant from Officers Candidate School, Aberdeen, Maryland, in January, 1943.

On retirement from active duty he rejoined Jones and Laughlin Supply Company in July, 1944, and has served since that time as city sales representative at Tulsa, Oklahoma.

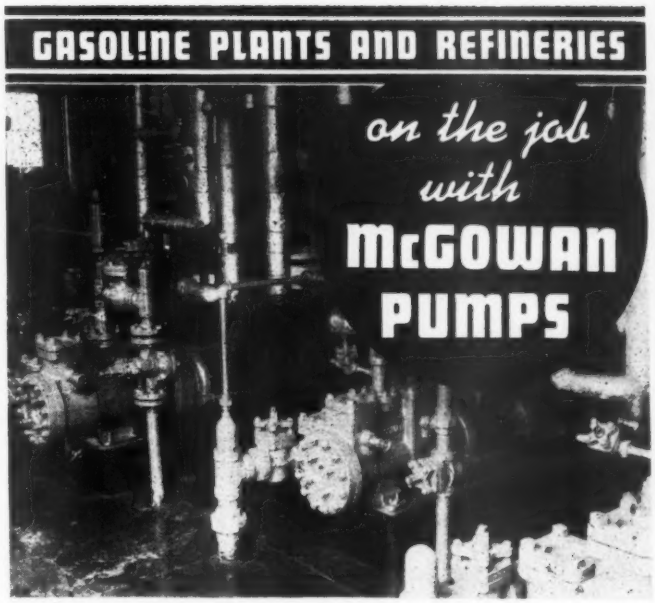
In reorganizing its export department, to sell domestic operators material and equipment for use in foreign fields, Jones and Laughlin Supply Company has enlarged its sales force in New York City and Street was selected for this important position due to his experience and training in oil industry needs. He will devote his entire time to the export trade.

D+B assistant manager sales

The appointment of Herschel Lewis as assistant manager of sales, D+B Mid-Continent division, has recently been announced by the D+B Division of Emsco Derrick and Equipment Company. Lewis will be in charge of sales in the states of Texas, New Mexico, Louisiana, Arkansas, and Mississippi.

Herschel Lewis

Lewis has a broad background of experience in the petroleum industry having spent 9 years with the Gulf Oil Company, Gypsy division, in both field and office operations. In 1937 he became associated with Lamtex Equipment Corporation of Fort Worth and was in active charge of the management of installation, servicing, and sales of Lamtex pumping equipment until his association with D+B in early 1944. His responsibilities for the last year and a half as manager of stores for the D+B Mid-Continent division have given him a thorough knowledge of Mid-Continent oilfield practices and problems. Lewis will continue to remain in charge of operation of Continental-D+B stores located in the above named states.



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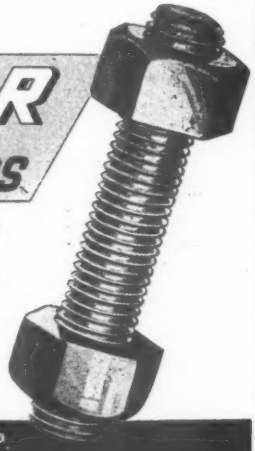

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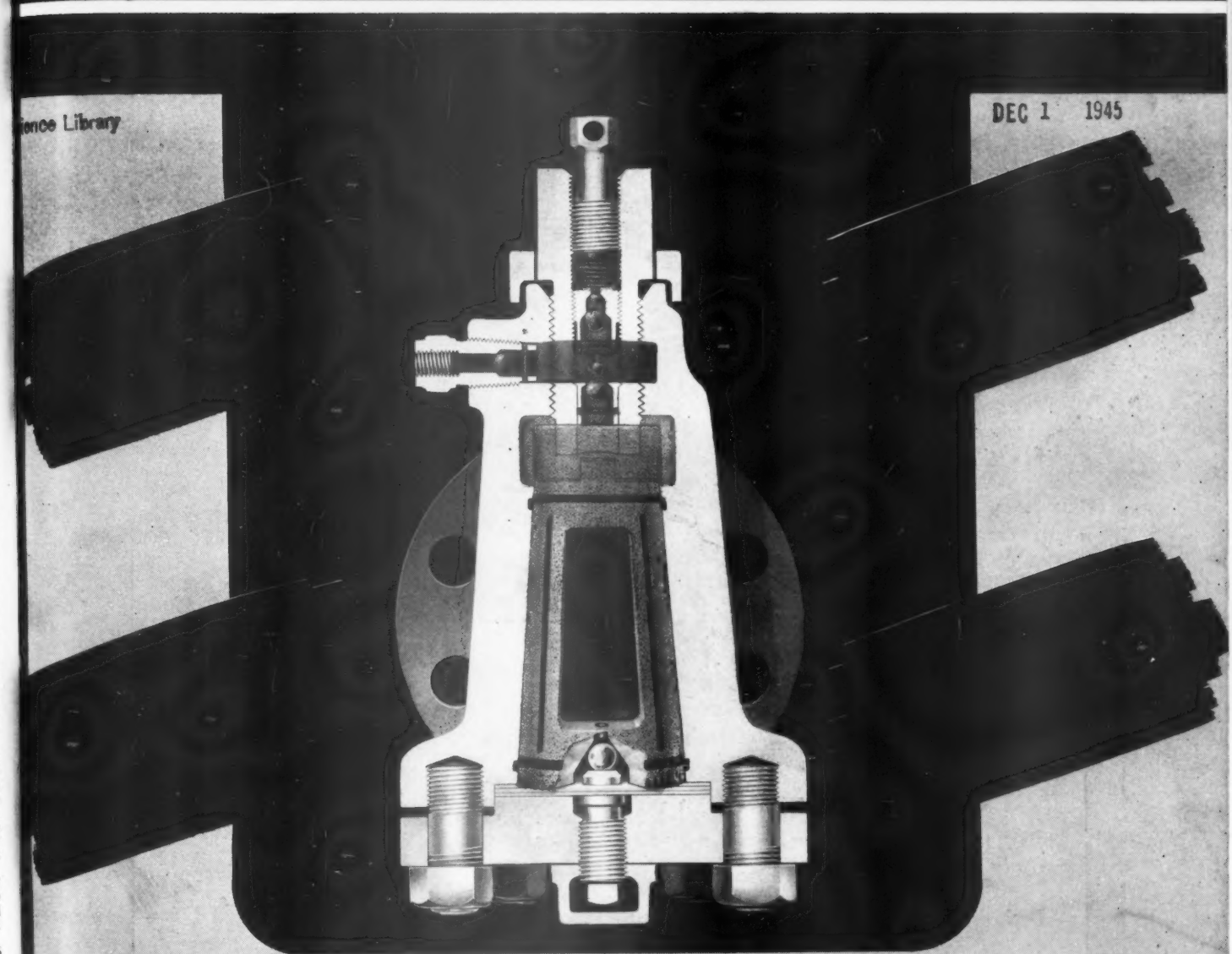

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